DELIVERING ART SERVICE IN THAILAND: PREDICTING FUTURE WORKFORCE REQUIREMENTS AND DEPLOYMENT PATTERNS ENABLING AND SUSTAINING UNIVERSAL ACCESS THROUGH DIFFERENT MODELS OF CARE

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Abstract

Thailand introduced universal access to Anti-retroviral treatment (ART) service in 2003. This became the main factor increasing demands for services with increasing numbers of People living with the Human Immunodeficiency Virus (HIV) and the Acquired Immune Deficiency Syndrome (AIDS), (PLHIV) and those people living longer. Since 2011, two other factors altered the ART service provision: changes in enrolment criteria to allow PLHIV with high CD4 count (a blood test that establishes the stage of immunosuppression), access to the ART service, and decentralisation changes allowing easier access to ART at peripheral levels. This study therefore examined how service providers at all levels of care deliver ART services, and developed a tool to estimate future requirements for those providers. The case study uses mixed methods including both quantitative and qualitative approaches. Two stages of data collection were conducted; fieldwork to collect data on activities and flow of ART services, and time required for each type of service provider. These become the input data for a second stage to project staffing requirements based on Markov and Monte Carlo analysis to 2025.

Three models of ART services were found, across all levels of facility in the public sector operating in high HIV/AIDS prevalence settings,: community-based, doctor-led and mixed-comprehensive. All models adapted their ART services from the national guidelines by applying HR strategies: task shifting, skill mix and community-based approach, to maintain/increase accessibility and quality of care. The estimation of time required to provide ART service of providers was estimated. 60 full time equivalent (FTE) providers (doctors, nurses, pharmacists, pharmacy technicians and non-healthcare providers) in 2012, projected to almost double in 2015. This study found negligible gaps (0.02-0.05%) between needs and availability of healthcare providers to deliver ART service.

The HR strategies investigated, were sufficiently widespread to be worth recommending for wide application in human resource planning. Moreover, the tool developed to estimate the requirements for healthcare providers from this study could further support forward towards planning for HIV/AIDS services in Thailand and possibly elsewhere.

Declaration

I, Thidaporn Jirawattanapisal, hereby declare that this submission is my own work and that, to the best of my knowledge, it contains no material previously published or written by another person no material which to a substantial extent has been accepted for the ward of any other degree of the Queen Margaret University or other institute of higher learning, except where due acknowledgement has been made in the text.

Signed: Thidaporn S.

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Dedication

This thesis is dedicated to my parents, my family, all teachers, supervisors, advisors, and the Royal Thai Government who have been supported me all required resources and the mental support for my academic ambitions. I will transform my knowledge and ability from my PhD study and experience in living in Edinburgh to return back as most benefit to strengthen the Thai healthcare system and other countries as best.

Abbreviations

AIDS	Acquired immune deficiency syndrome
A2	The Analysis and Advocacy Project
AEM	Asian Epidemic Model
ARV	Anti-retroviral
ART	Anti-retroviral therapy
CDC	Central for Disease Control and Prevention
CD4	Cluster of differentiation 4
CSMBS	Civil Servant Medical Beneficiary Scheme
F	Female gender
FTE	Full-time equivalence
WPRO/RTC	WHO Western Pacific Regional Office/ Regional Training Centre
HIV	Human immunodeficiency virus
HRH	Human resource for health
HRM	Human resource management
HRP	Human resource planning
IDU	Injecting drug user
LMIC	Lower and middle income countries
M	Male gender
MOPH	Ministry of Public Health
MDG	Millennium Development Goal
MSF	Médicins sans Frontières
MSM	Men who having sexual intercourse with men
NGOs	Non-government organizations
NHSO	The National Health Security Office
OECD	The Organisation for Economic Co-operation and Development
OPD card	Outpatient procedure card
PHC	Peripheral healthcare
PLHIV	People who were estimated to be living with HIV/AIDS
SSS	Social Security Scheme
UA	Universal access
UC	Universal coverage

UN	United Nations
UNAIDS	Joint United Nation Programme on HIV/AIDS
WHO	World Health Organization

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CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

This thesis explores issues affecting the healthcare system delivery of HIV/AIDS treatment, focusing on the immediate and long-term requirement for human resources in Thailand.

Section 1.1 outlines the background and issues which inspired the research; the impact generated by HIV/AIDS on human survival and economic status as the disease developed into a global epidemic; and specifically, the effects on the healthcare system and health workforce.

Section 1.2 presents the context of the study, its major foci, and an account of some of the areas of concern. Section 1.3 indicates the specific foci of this study. The purposes, specific aims, and objectives are presented in section 1.4. It was important to anticipate problems which might arise during the field study, to ensure the achievement of the research objectives. Section 1.5 defines the significance and scope of the research and gives definitions of the terms used in the study. Section 1.6 presents research appraoach. Section 1.7 includes an outline of the remaining chapters of the thesis. The conclusion of the chapter is in Section 1.8.

1.1 BACKGROUND

The key foci of this section are the impact of HIV/AIDS on human survival and on the healthcare provision. At the time the study was conducted, there were approximately 35 million PLHIV (Joint United Nations Programme on HIV/AIDS 2013), globally; this number continues to increase, underlining the need for effective policies and programmes to deal with this global pandemic (Joint Learning Initiative 2004; Joint United Nations Programme on HIV/AIDS 2013).

An expectation over the past several centuries has been to have a steady improvement in the health of human beings, "health" being defined as a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity[1]. Also considered as part of the definition are physical strength and fitness, including concepts of energy, vitality and an ability to cope with life situations among younger age groups, and mental and physical well-being, the capacity for activity, and the absence of illness among older people (Blaxter 1994; World Health Organization 1948).

The curative and preventive care provided by the healthcare system is identified as a concern in the promotion of health (Abel-Smith 1994). Accordingly, Acquired Immunodeficiency Syndrome (AIDS): the disease caused by the human immunodeficiency virus (HIV), demands action, involving collaboration between preventive/health promotion and curative care. This communicable disease has generated serious impact individually, nationally, and now globally because of its

[1] Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19th June – 22nd July 1946; signed on 22nd July 1946 by the representatives of 61 States (Official Records of the World Health Organization, no. 2, p. 100) and entered into force on 7th April 1948. The definition has not been amended since 1948. tp://www.who.int/suggestions/faq/en/ accessed November 30, 2005

particular biological and pathological characteristics (World Health Organization and Joint United Nations Programme on HIV/AIDS 2009).

1.1.1 Biological and epidemiological impact of HIV/AIDS

The HIV/AIDS pandemic has a direct impact on human life, being transmitted from person to person in blood, semen, vaginal fluids, and breast milk. The virus enters the body and attaches itself to a particular set of host cells in the human immune system, directly attacking and destroying these clusters of differentiation4 (CD4) cells. After a window-period of between 3 weeks and 3 months, the presence of HIV antibodies can be detected, and their presence defines that person as HIV positive. Simultaneously to the reduction in CD4 cell count, from a high of between 500 and 1,500 cell/mm^3 in a healthy person, the copies of the virus in the blood increase. If untreated, the disease typically progresses slowly; on averageover 1 to 10 years, from asymptomatic infection with no visible signs of the presence of HIV, to full-blown AIDS (Joint United Nations Programme on HIV/AIDS 2013; Barnett and Whiteside 2006; Jaffar et al. 2004; Welz et al. 2010).

CD4 level is one of the clinical markers of HIV infection progression. Once the CD4 level has decreased to 200 cell/mm^3, the body becomes vulnerable to opportunistic infections, which exploit the opportunity presented by a weak immune system. Continuing immune system deficiency will result in AIDS (Barnett and Whiteside 2006; Jaffar et al. 2004; Welz et al. 2010).

The US Center for Disease Control and Prevention (CDC) classified the severity of HIV disease by CD4 cell count and the presence of specific HIV-related conditions (Centers for Disease Control and Prevention 2008). In contrast to the CDC system, the World

Health Organization clinical staging and Disease Classification System can be more easily used in resource-constrained settings without access to CD4 cell count measurement, viral load testing or other laboratory testing methods (World Health Organization 2006c).

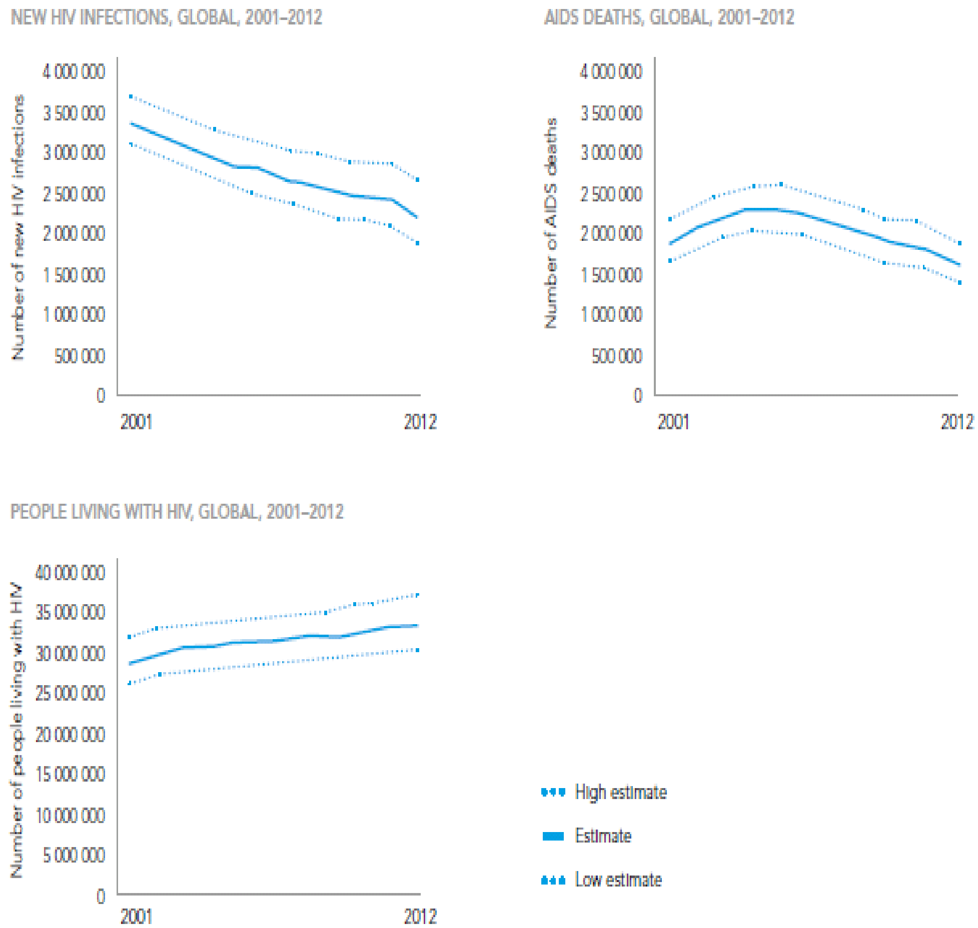
HIV/AIDS affects both adult and infant mortality, by mother-to-child transmission: about 13-45% of children born to infected mothers are themselves infected (Bryson 1996). Infant mortality and life expectancy are also indicators for measuring national progress and development. The impact of AIDS on life expectancy means that fewer people will survive a normal lifetime, and the number of years an infant can expect to live will be lower (Joint United Nation on HIV/AIDS 2013; Joint Learning Initiative 2004). The notable impact of the HIV/AIDS pandemic on life expectancy at birth can be seen in Sub-Saharan African countries: for example, in Zimbabwe, it was estimated that life expectancies plunged, reducing from 57 and 70 years to 49 and 38 years, between 1980 and 2002, for males and females respectively. In Zambia, life expectancy was reduced from about 50 years in 1980 to 36 years in 2002 (Barnett and Whiteside 2006; Joint Learning Initiative 2004).

In terms of the numerical data of the HIV/AIDS epidemic, over 25 million people have died as a result of the disease since the first case was identified in 1981. However, the number of people infected each year has decreased markedly; from 3.1 million in 1990, to 2.6 million in 2009, and 2.3 million in 2013, an overall reduction of 20% (Joint United Nations Programme on HIV/AIDS 2010; 2013).

In 2012, 35.3 (32.2 - 38.8 high and low estimates) million people were estimated to be living with HIV/AIDS (PLHIV), among whom 1 million were children under 15; there were 2.3 (1.9 - 2.7 high and low estimates) million new infections (a 34% decrease compared to 2001); 1.6 million AIDS related deaths, this figure also showing a decreasing trend; and about 430,000 children were born with HIV infection. Sub-Saharan Africa is the region most affected, and is home to 67% of all PLHIV.

The annual numbers of new HIV infections and death have steadily declined (Figure 1.1), (International HIV and AIDS Charity (AVERTing HIV and AIDS) 2012a, b, c; Joint United Nations Programme on HIV/AIDS 2009; 2010; 2013).

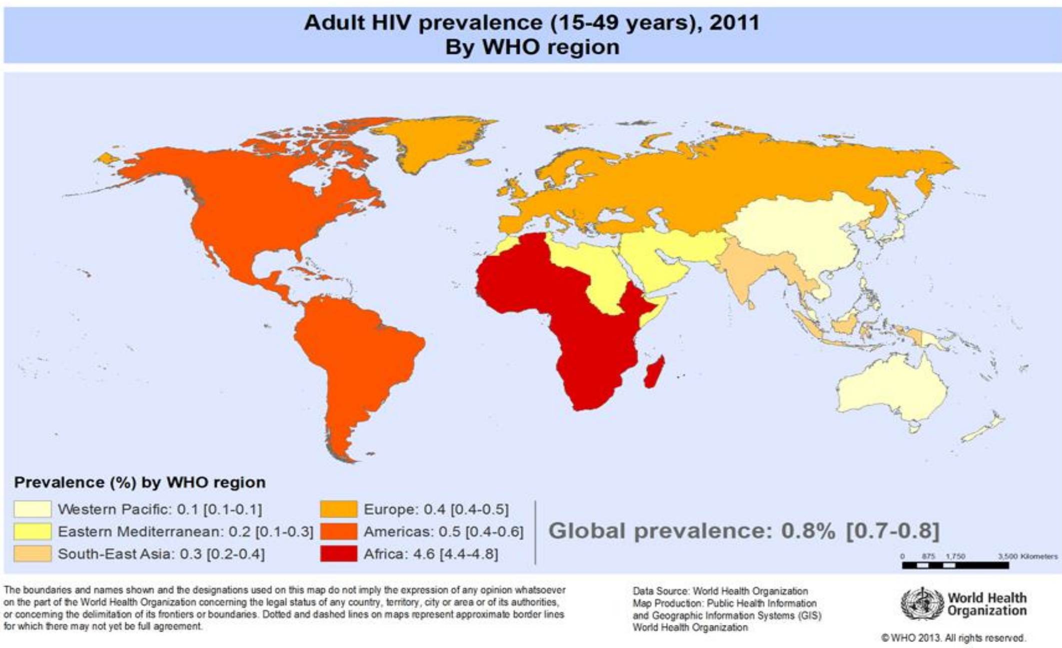
Figure 1.1 The global numbers of PLHIV, those newly infected with HIV and deaths due to AIDS, 2001-2012



Source: Joint United Nations Programme on HIV/AIDS 2013

Regionally, the countries of sub-Saharan Africa bear the greatest burden of the epidemic, being the home of about 22.9 million PLHIV, 67% of the worldwide number; and having the highest percentage of PLHIV (>15-28%), Figure 1.2.

Figure 1.2 The global prevalence of HIV, as of 2011



Source: Joint United Nations Programme on HIV/AIDS 2013

In 2009, an estimated 11.3 million PLHIV were living in the 10 countries of southern Africa (34% of the global figure). In 2009, in sub-Saharan Africa, the estimated 1.3 million people who died due to AIDS represented about 72% of the global total of 1.8 million deaths attributable to the disease (International HIV and AIDS Charity (AVERTing HIV and AIDS) 2012a).

South-East Asia carries the second-highest burden of the epidemic, with over 4 million PLHIV in 2009: Figure 1.2 and Table 1.1.

Table 1.1 Global numbers of PLHIV, HIV/AIDS prevalence and deaths at the end of 2011 by region

Region	Adults & children living with HIV/AIDS	Adults & children newly infected	Adult prevalence*	AIDS-related deaths in adults & children
Sub-Saharan Africa	22.9 million	1.9 million	5.0%	1.2 million
North Africa and Middle East	470,000	59,000	0.2%	35,000
South and South-East Asia	4 million	270,000	0.3%	250,000
East Asia	790,000	88,000	0.1%	56,000
Eastern Europe and Central Asia	1.5 million	160,000	0.9%	90,000
Latin America	1.5 million	100,000	0.4%	67,000
North America	1.3 million	58,000	0.6%	20,000
Western and Central Europe	840,000	30,000	0.2%	9,900
Caribbean	200,000	12,000	0.9%	9,000
Oceania	54,000	3,300	0.3%	1,600
Global Total	34 million	2.7 million	0.8%	1.8 million

Note: * Proportion of adult PLHIV aged 15-49

Source: International HIV and AIDS charity (AVERT HIV and AIDS) 2012

The epidemic in most Asian countries appears to have stabilized; in Thailand, this is at close to 1% of the population; the trend of infection has remained relatively stable and is still largely concentrated among high-risk groups. No country in the region has an HIV/AIDS prevalence higher than 1% (Joint United Nations Programme on HIV/AIDS 2013).

The HIV/AIDS epidemic among the Thai population is classified as a concentrated epidemic-scenario where HIV prevalence is high in one or more sub-populations: men who have sex with men, injecting drug users, and sex workers and their clients; the virus is not circulating in the general population (Joint United Nations Programme on HIV/AIDS 2007; Ministry of Public Health 2010c). The epidemic in Thailand originated among male homosexuals and spread to injecting drug users, female sex-workers, heterosexual males, and eventually to the families of these groups. Annual new infections peaked in the early 1990s, estimated at more than 100,000 new infections per year; in 2008, with a prevalence of 1.02% among a population of 67 million (Central Intelligence Agency 2011; Central Intelligence Agency July 2013).

Thailand had an estimated 28,000 AIDS-related deaths and 562,243 PLHIV in 2005. The projection from the team of Thai working groups on HIV/AIDS[2] is that in 2025, there will have been a cumulative number of 1.2 million PLHIV, 70,000 of them children, of whom only 320,000 will still be alive. Annual incidence of infection is estimated to reduce to 6,500 (500 of them children) by 2025; annual numbers of full-blown AIDS

[2] Thai working groups on HIV/AIDS consisted of the AIDS division of Department of Disease Control, the Ministry of Public Health, the National Economics and Social Development Board (NESDB) and both Thai and international partners made projections to ascertain the number of HIV infections, cases of AIDS, AIDS related deaths and other key information about HIV/AIDS in Thailand. They made projections for an epidemic of HIV/AIDS and the consequent number of PLHIV in Thailand in 2001. The projections were used in the preparation of policy discussions such as in the National AIDS Committee. The latest version of the projection was revised in 2005.

cases to 16,500 (1,500 of them children) and annual deaths to 18,000 (Thai Working Group on HIV/AIDS 2008). This is a burden of HIV/AIDS disease impacting to Thai healthcare system.

In summary, the biological features of HIV are such that it remains a significant and serious disease not easily controlled. The epidemic is global, but different countries demonstrate different mortalities by the different incidences and the responses that the healthcare systems of those countries provided. Thailand has a very specific epidemic that continues to seriously impact on the burden of disease among certain groups.

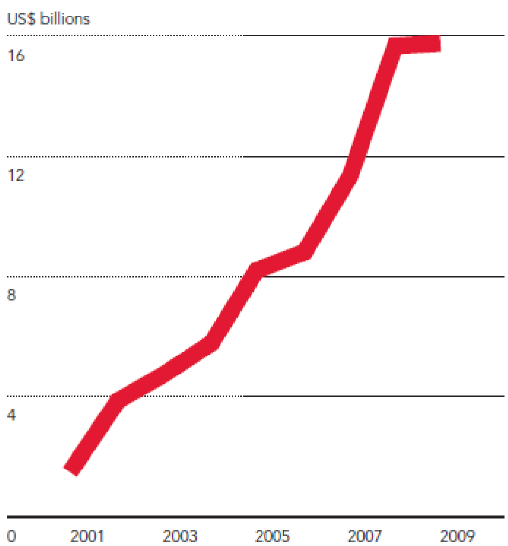
1.1.2 The economic burden of HIV/AIDS

HIV/AIDS also has a marked effect on the economic status of a country, especially from the commitment of policy strategies for treating PLHIV, which might displace other types of health- and social welfare expenditure (World Health Organization 2006e; Joint United Nation Programme on HIV/AIDS 2013; World Health Organization 2013).

HIV/AIDS has the potential to significantly reduce the economic status of small family units; many PLHIV have lost their jobs because of their illness, both because they were too ill to work and because of the stigma associated with a positive HIV status. Many infected children have been taken out of school; some families have had to spend all their income to access treatment. However, after the improvement in health resulting from treatment, some are able to return to work, with the knowledge of how to protect themselves and others from infection, thus helping to curtail the spread of the disease.

HIV/AIDS has had an enormous economic impact at the national and international level; financial and human resources have had to be spent to tackle the problem, and governments have had to take responsibility for these challenges; their most serious concern being the cost of interventions which will be needed for the lifetime of every PLHIV. The cost of antiretroviral drugs has to be seriously considered in any strategic plan, and this will depend on national and international markets. Data from UNAIDS concerning this expenditure in 1999 indicates that most governments do not have enough information about the estimated cost of care to permit practical planning for the future. The rapid expansion in HIV services, including prevention, treatment and care, was followed by earmarked AIDS financing, which rose from 1.6 to 15.9 billion USD between 2001 and 2009 (Figure 1.3).

Figure 1.3 Global resources available for HIV treatment in low- and middle-income countries, 2001 to 2009



Source: Joint United Nations Programme on HIV/AID 2010

The ART programme consumed over half the available financial resources, and almost a quarter were used for HIV prevention (Joint United Nations Programme on HIV/AIDS 2010). The global report on scaling up the priority of HIV/AIDS intervention in the health sector shows that at the end of 2008, the major sources of financing for HIV programmes were domestic, accounting for 52% of all investments, followed by 31% from direct bilateral cooperation, 12% from multi-lateral institutions and 5% from the philanthropic sector (Joint United Nations Programme on HIV/AIDS 2009). In Thailand, since 1986, the government has taken the lead in attempting to alleviate the significant impact of a cumulative total of one million people infected with HIV, putting the equivalent of over 2 billion USD a year into the health system to implement preventive and curative treatment, two-thirds of this funding being allocated to curative care (Ministry of Public Health 2010c). Since the introduction in 1996 of a policy to treat PLHIV with ART free of charge (Panupak 2004), the government has continued to show a strong commitment to addressing the problems surrounding HIV/AIDS, expanding the programme in 2003 to provide universal access to ART for all PLHIV in Thailand. This internationally acclaimed programme has been effective: hospital admissions, use of accident and emergency services (Vassvid et al. 2004), and morbidity and mortality of PLHIV have all decreased (Chasombat et al. 2006; Chasombat et al. 2009; Ruxrungtham et al. 2004).

Table 1.2 shows a report of the expenditure in 1999 on treatment per PLHIV in seven countries. Of these, Thailand spent the most (over 100 USD per PLHIV). Most of this (94.95 USD) was from domestic/national sources. Most countries in sub-Saharan Africa spend much less, despite, or perhaps to some degree because of, a much higher rate of HIV infection. Moreover, their funds are not from domestic sources, with the exception of Botswana.

Table 1.2 UNAIDS report showing HIV/AIDS expenditure per PLHIV

Country	Adult HIV prevalence rate in 1996 (per 100 of population)	Total funds per HIV infected person (USD)	Domestic fund per HIV infected person (USD)
Zimbabwe	25.84	9.32	0.03
Botswana	25.10	14.27	14.27
Cote d'Ivoire	10.06	10.85	1.62
Uganda	9.51	40.41	2.73
Thailand	2.23	100.65	94.95
Senegal	1.77	59.63	4.69
Ukraine	0.43	1.50	0.00

Source: Joint United Nations Programme on HIV/AIDS 1999

Many national and international efforts to alleviate HIV/AIDS have had a positive outcome in some countries, reducing infection rates significantly; however, in other countries, infection rates have remained the same or worsened. UNAIDS reported changes in the rates of HIV infection worldwide, between 2001 and 2009, in three groups: an increase of over 25%, a stable rate, and a decrease of more than 25%. Most sub-Saharan African countries show adecreasing trend (Joint United Nations Programme on HIV/AID 2013), but infection rates in some were unchanged, as were those in some other countries. In summary, HIV/AIDS had anprofound effect on economic status. Many countries, when faced with the problem of HIV/AIDS, committed to treating those affected, to alleviate the problem, prolong the lives of PLHIV, and reduce deaths. This required long-term financial commitment to the healthcare system of these countries.

1.1.3. Impact of HIV/AIDS on the healthcare system and the health workforce

Many healthcare systems have been unable to cope adequately with the increased burden imposed by HIV/AIDS. Health workers[3] have been overstretched, owing to inadequate numbers and lack of economic, political and social support. For instance, studies in Mozambique and Malawi reported that there were not enough health workers; of those there are, many do not have the right skills, and are over stretched, over stressed, and not in the right place (maldistribution), (World Health Organization 2006f).

Firstly, the increased workload the HIV/AIDS epidemic imposes on health workers (Joint United Nations Programme on HIV/AIDS 2013). Since the launch of the ART programme, health workforces have been forced to assume extra responsibilities and leadership, and the push to scale up ART is aggravatingthis situation. The study of McCoy and Schneider showed adeflection of technical support from healthcare workers, and resources from other healthcare needs and services (McCoy et al. 2005; Schneider et al. 2006a).

Many other studies identified similar problems: health services in poorer countries already bore the burden of staff-shortages, poor facilities and lack of financial resources and long term investment, and after their governments responded to the need for ART services, the health systems faced even more difficulties (Joint Learning Initiative 2004; Schneider et al. 2006a; Van Damme and Kegels 2006). Sub-Saharan African countries already have stressed health systems. The World Health Organization HRH database reports that Malawi and Mozambique have limited numbers of doctors: between one and two per 100,000 of the population, whereas South Africa, the United Kingdom and

[3] Health worker is defined as all the people engaged in actions whose primary intent is to enhance health, including community workers and barefoot doctors, to such professional health cadres as doctors and nurses working in the healthcare system.

the United States of America have about 69,166 and 549 doctors per 100,000 of the population, respectively (World Health Organization 2006f).

Secondly, HIV/AIDS has been directly responsible for healthcare staff losses in many countries. In a mature HIV/AIDS epidemic with no availability/accessibility toART, health workers have become infected in the workplace, leading to death, resignation or early retirement, all major causes of attrition among health workers. For example, between 1991 and 1992, the prevalence of HIV among nurses in Lusaka increased from 34% to 44%, compared with a prevalence of between 17 and 20% in the general population (Ndongko and Oladepo 2003). In Thailand, the prevalence of HIV infection among healthcare workersis assumed to be the same as that in the general population: about 1% (Ministry of Public Health, 2010c). The spread of HIV/AIDS also lowers morale among health workers; physical stress, caused in part by understaffing, causes fatigue, burn out, and absenteeism, which all contribute to staff losses. Few African hospitals have access to ARV drugs, so the consequences of infection are dire (Joint United Nations Programme on HIV/AIDS 2013). In Malawi 45% of staff deaths were due to AIDS-related illnesses (Tawfik and Stephen 2003). A study of Tawfik and Stephen suggested that African health systems mightlose 20% of their workers to HIV/AIDS over the next few years(Tawfik and Stephen 2003). Approximately 10% of PLHIV die each year: in countries with 39% sero-prevalence in the general population, a similar prevalence among healthcare workers means that about 3% will die annually. A study in Zambia, South Africa and Botswana illustrated the high attrition rate from HRH related to HIV/AIDS (Buve et al. 1994; World Health Organization 2004b). In Africa overall, about 20 % of healthcare workers died of HIV/AIDS (Joint Learning Initiative 2004), less than half the Malawian figure (45%), (Joint Learning Initiative 2004).

Migration is the other main reasons for the depletion of the healthcare workforce in countries that can least afford it. There is evidence of the impact of scaling up the ART programme on the migration of health workers looking for better living and working conditions (Schneider et al. 2006a; Van Damme et al. 2008). Countries with weak human resources for health services will also have difficulties reaching their scaled-up target coverage. Rapid scaling up of ART and increased efforts to reduce HIV transmission are identified as needs, while numbers of healthcare workers to deliver these services are limited, and some are rapidly decreasing (Kober and Van Damme 2004). In South Africa, if the target of the ART programme (1 million PLHIV to have access to services by 2009) were to be met, about a quarter of the doctors in the public sector (a total of 7,645) would have to spend their whole time delivering ART services. In Mozambique, it was estimated that about 264 medical doctors were needed to treat 132,000 PLHIV, although there were only 360 medical doctors in the country. With similar populations of PLHIV and a limited healthcare workforce, Malawi, Zambia, Rwanda and Tanzania all need strategies to enable them to provide the ART services the PLHIV in their countries need (Van Damme et al. 2008).

The challenges and potential burden of increased services are especially profound in countries with a high prevalenceof HIV/AIDS and shortages of HRH, as in sub-Saharan Africa (George et al. 2010). In Malawi, ART has been called provider-intensive because the programme would require 44-88.8 % of the clinical officers, 13.6% of the physicians, and 47.6 % of the registered nursesin the whole health workforce to provide ART services for the 170,000 PLHIV (Muula et al. 2007).

The current HRH decade: 2006-2015 (World Health Organization 2005), indicates that the shortage of health workers is a global HRH crisis, constraining the achievement of the three health-related Millennium Development Goals (MDGs)[4]: to reduce child mortality, improve maternal health, and combat HIV/AIDS and other diseases. The first insufficiency is the shortage of health workers, and the fact that many of those available do not have the right skills and support networks. Additionally, they are overstretched, overstressed and not in the right places. The Joint Learning Initiative (Joint Learning Initiative 2004b) reported that an HIV/AIDS-increased workload was one of the major causes of the crisis (World Health Organization 2006g).

Attempts are being made to evaluate and estimate the needs and requirements for healthcare workers to deliver ART services (Van Damme W et al. 2008; Van Damme W et al. 2007; Kober and Van Damme 2006; World Health Organization 2006g), since until recently these needs have been addressed by merely topping up the existing health workforce. A number of countries have estimated the HRH requirements for their ART programmes on the basis of a model which depends on physicians. For example, a study in Zambia and Mozambique (Smith 2005) projected that if these countries were to scale-up ART and make it available for all clinically eligible people within the next ten years, they would require, for this activity alone, twice as many doctors in Zambia, and four times as many in Mozambique, as are currently available in these countries.

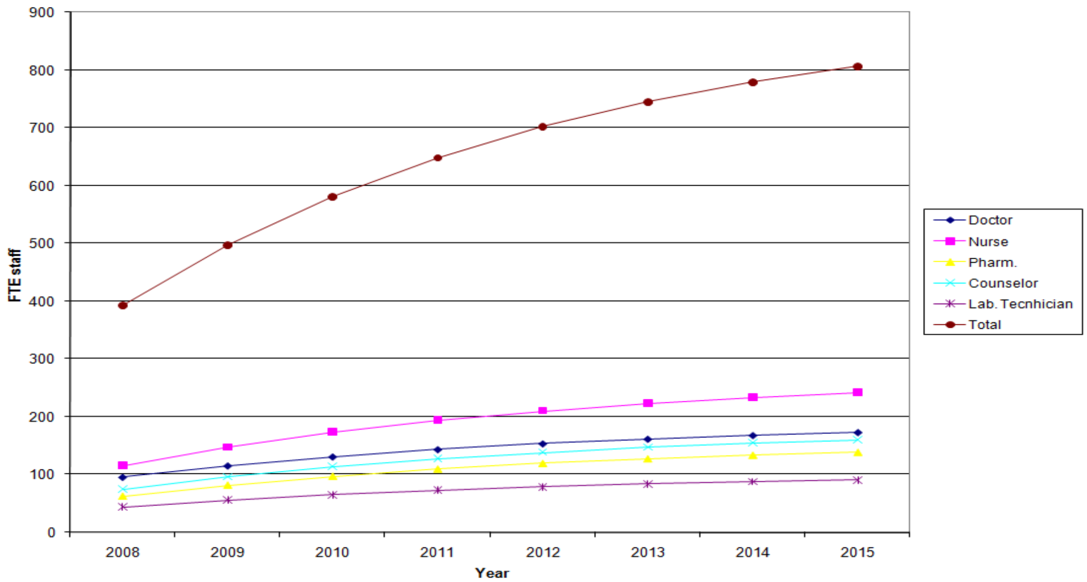
Similarly, Muula et al (Muula et al. 2007) and Hanefeld and Masheke (Hanefeld and Masheke 2009) found that Malawi and Zambia would require ten times the workforce of Southeast Asia to provide scaled-up ART services, and that there were insufficient

[4] The United Nations Millennium Development Goals are eight goals that all 191 UN member states have agreed to try to achieve by the year 2015. The United Nations Millennium Declaration, signed in September 2000, commits world leaders to combatting poverty, hunger, disease, illiteracy, environmental degradation, and discrimination against women. The MDGs are derived from this Declaration, and all have specific targets and indicators.

skilled healthcare workers available for a doctor-based ART delivery model similar to those in Mozambique, Rwanda and Tanzania (Van Damme W et al. 2007).

In Asia, a study in Cambodia estimated that there were sufficient service providers to deliver ART with 2.06 full-time equivalent (FTE) doctors to 522 ART clients, and 1.97 FTE doctors for 911 patients in 2004, and between 2 and 5 FTE doctors for ART by 2013 for over a thousand (Van Damme et al. 2007). A Thai study in 2008 used data from experts concerning the time required to provide ART services, numbers of PLHIV estimated by the Asian Epidemic Model (AEM), estimated numbers of new-case PLHIV, PLHIV following up with and without complications, in the calculation of the FTE requirement to provide ART services (Jirawattanapisal 2009; Jirawattanapisal et al. 2010). The results indicated a higher requirement; 393 FTE of the five cadres of healthcare providers (doctor, nurses, pharmacist, laboratory technician and counsellor) for 104,212 ART clients. The largest requirement within this figure was for nurses (29 FTE), followed by doctors, counsellors, pharmacists, and laboratory technicians: 24, 19, 16, and 11of FTE, respectively: Figure 1.4. The study also projects forward to 2015, indicating a doubling of the requirement to 806 FTE health professionals for 265,176 ART clients (Jirawattanapisal 2009; Jirawattanapisal et al. 2010).

Figure 1.4 Projection of requirement of the full-time equivalent (FTE) of healthcare providers for ART in Thailand: 2008 to 2015



Source: Jirawattanapisal et al. 2010

There is global recognition that human resources have a major influence on the performance of health systems, and that there is a crisis in the health workforce (World Health Organization 2006e). The provision of ART is not an exception (Kober and Van Damme 2006; World Health Organization 2004a). The reasons identified were 1) insufficient investment, 2) the global market for health workers or migration, meaning that they can move from under-resourced to better-resourced areas of the world, leaving the under-resourced areas even worse off than before, and 3) the HIV/AIDS epidemics which have added a new burden to health systems (Joint Learning Initiative 2004). ART delivery is a highly labour-intensive undertaking, in which success is closely linked to both numbers of workers available and their occupational motivation (Steyn et al. 2009b; Van Damme et al. 2008).

The impact of the HIV/AIDS pandemic aggravates and accelerates these HRH problems, compounding an already difficult situation. Moreover, ART professionals have reported an overall decline in the quality of care provided to PLHIV (Bodenlos et al. 2007; Tobi et al. 2008), alleging that this was because of the increasing numbers of PLHIV accessing ART services, increasing workforce shortages and skewed distribution in the health workforce, and the heavy workload among ART service providers.

HIV/AIDS also led to loss of motivation, stress and depression caused by overwork in a poorly resourced working environment. Health care workers also feel unsafe at work, because of the possibility of HIV infection (Joint United Nation Programme on HIV/AIDS 2013).

The situation was most serious in Africa, because there were few hospitals providing ART services: healthcare workers felt that if they were infected, they would die, as treatment would be unavailable (George et al. 2010). Studies in Swaziland (Mkhabela et al. 2008), South Africa and Kenya (Schneider et al. 2006a; Tobi et al. 2008) reported health workers involved in providing scaled-up ART services as demoralised, overworked and burned-out, owing to an increasing number of PLHIV. However, another factor causing stress was a decreasing number of health workers, therefore a higher workload, resulting in growing emotional and physical stress, and job dissatisfaction, pushing many out of the public sector (Dieleman et al. 2007).

However, some studies presented a positive picture: of the health workforce gaining satisfaction from their work with HIV/AIDS patients. George et al (2010) conducted a study in two South African districts, and reported a high level of job satisfaction among ART workers (George et al. 2010). They enjoyed coming to work every day because of the positive impact of the service they provided. They felt a sense of achievement in saving the lives of PLHIV, and promoting the health of people formerly seen as untreatable. They felt that they could give hope to PLHIV, and allow them to live a normal life; these feelings compensated for the tiredness and stress endured at work. Similar studies have also reported that the scaling-up of the ART programme was an opportunity to build strong and effective health systems, and in particular, human resource capacity, specifically in the public sector (McCoy et al. 2005; Tobi et al. 2008).

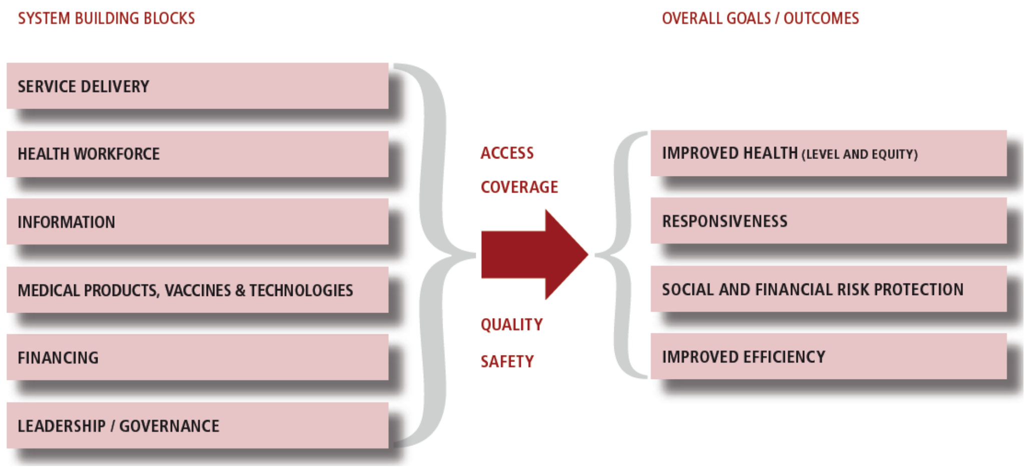
Thailand has been hard hit by HIV/AIDS; about 1 million have died since the first identified case in 1987, and about half a million are PLHIV. Thai people are faced with an infection rate of about 1%. Its incidence is dramatically higher in some groups than in the general population: MSM, IVDU and youth. This reflects the burden of HIV/AIDS that the government and involved partners have to deal with.

1.2 CONTEXT

1.2.1 ART service

The World Health Organization (WHO) introduced six blocks of health system framework; service delivery, health workforce, information, medical products/vaccines and technologies, financing, and leadership/governance. Overall goals/outcomes are improved health, responsiveness, social and financial protection and improved efficiency, (Figure 1.5), (World Health Organization 2007a; 2010e).

Figure 1.5 The six building blocks of the WHO health system framework



Source: World Health Organization 2010a, 2010e

The ART programme is anintervention which relates directly to all blocks in the framework. The health workforce is the focus of this thesis. HIV/AIDS is a chronic, communicable disease that needs a strong healthcare system to drive the ART service, ensuring quality and safety (World Health Organization, 2010a); a strong healthcare system requires an efficient health workforce to deliver a high quality andsafe service to improve the lives and health of PLHIV.

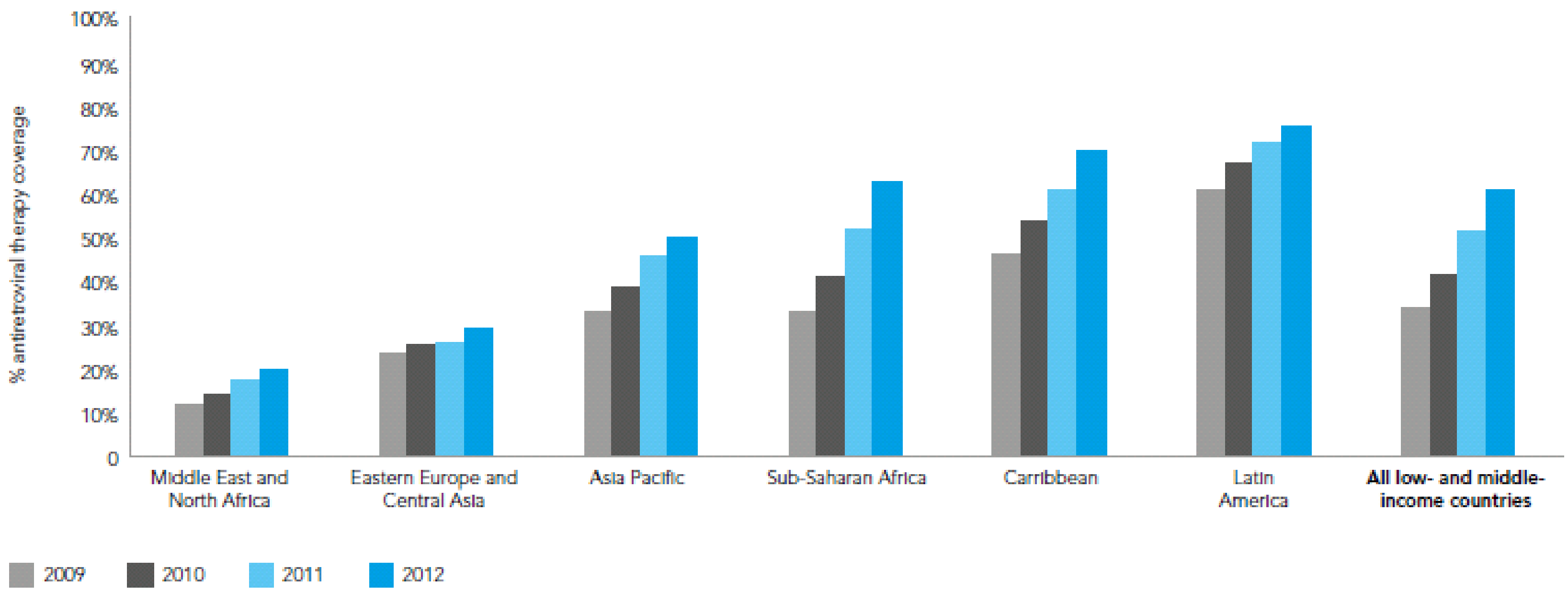
Even after years of planning, effort and improved access to ART, many goals have not been achieved. Between December 2003 and 2005, there was a threefold increase in PLHIV accessing ART services. However, a failure to achieve the target of universal access (UA) was found. Only 1.3 million PLHIV were able to access ART services (World Health Organization 2006a; World Health Organization 2006d). In 2010, global communities continued to move forward to bring treatment to all PLHIV. 'Treatment 2.0' was a new approach determined to prevent ten million deaths, including those of the nine million PLHIV then not accessing ART, and those subsequently infected, by 2025 (Hirnschall 2012; Joint United Nations Programme on HIV/AIDS 2012; World Health Organization and Joint United Nations Programme on HIV/AIDS 2011). This approach is also expected to reduce the number of newly infected people by up to 1 million annually, if countries provide antiretroviral therapy to everyone who needs it, following the 2010 WHO treatment guidelines (World Health Organization 2010a).

In practice, Treatment 2.0 was planned to simplify HIV treatment and scale up access to anti-retroviral drugs, thereby reducing treatment costs, simplifying treatment regimens, reducing the burden on health systems and improving the quality of life for PLHIV. The principal outlines of Treatment 2.0. are a range of processes designed to adapt to the evolving global health and development architecture, as well as the challenges posed by fiscal constraints on health and development budgets (World Health Organization 2010a); these steps relate to the health targets established in Millennium Development Goal (MDG) 6: first to stop, and then begin to reverse the AIDS epidemic by 2015 (Joint United Nations Programme on HIV/AIDS 2013).

At the end of 2012, the number of PLHIV receiving ART (9.7 million[5]) was about double that in 2008 (5,254,000). The percentage accessing ART in 2012 was over 61% of all PLHIV in LMIC, receiving ART under the WHO guideline 2010 (Joint United Nations Programme on HIV/AIDS 2013). This achievement reaches almost two-thirds of the way towards the target of 15 million people receiving ART by 2015. Figure 1.6 presents the percentage of coverage of ART in LMIC. The coverage showed an increasing trend between 2009 and 2012, in all continents.

[5] This reflects the number of people waiting for enrollment by some barriers. The percentage as 37, 42, 51, 48 and 19 of people who eligible to be treated in sub-Saharan Africa, Central and South America, Oceania, Caribbean and Eastern Europe and Central Asia were access the ART, respectively.

Figure 1.6 The number of PLHIV receiving and needing ART, and the percentage of coverage in low- and middle-income countries by region, from the end of 2008 to the end of 2012

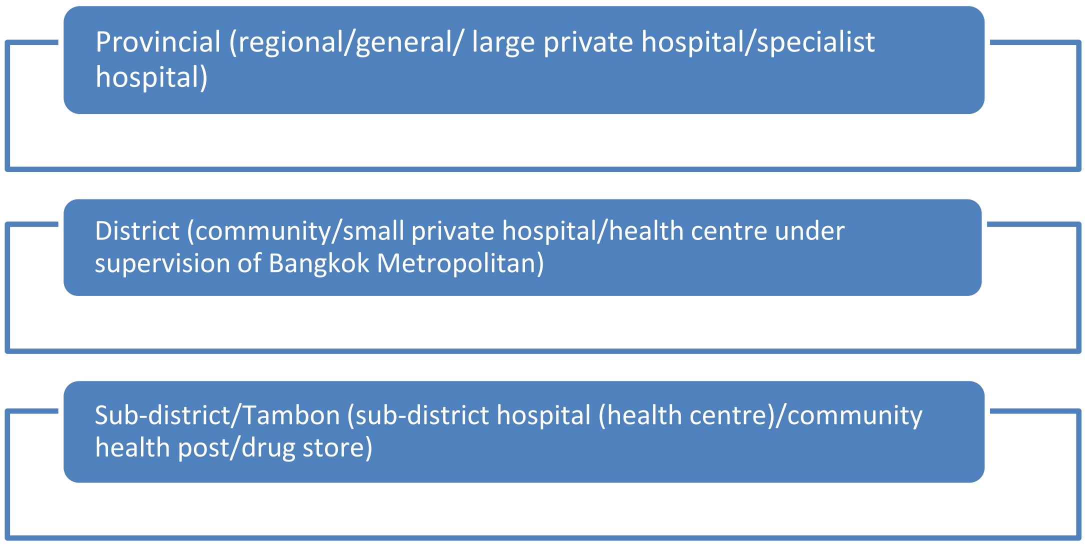


Source: Joint United Nations Programme on HIV/AIDS 2013

In Thailand, the healthcare system is dominated by the public sector. In 2007, there were 9,762 rural health centres covering all sub-districts (Tambons), and sub-district health promotion hospitals (SHPH) have been operating (transformed from health centres) fully since September 2011 (Ministry of Public Health 2010a). The public healthcare system also ran 730 hospitals (ranging in size from 10 to 150 beds) covering 92% of all districts; 70 general (provincial) hospitals; 25 regional hospitals; 59 military hospitals; 47 specialized hospitals; and 11 teaching hospitals (see Figure 1.7). In total, these public facilities provided 141,451 beds (Ministry of of Public Health 2007). In the private sector, there were 344 private hospitals providing 35,806 beds which represented20% of the total hospital beds in the country. In addition, there were 16,800 private clinics and 14,000 pharmacies. Private health facilities operated mainly in urban areas.

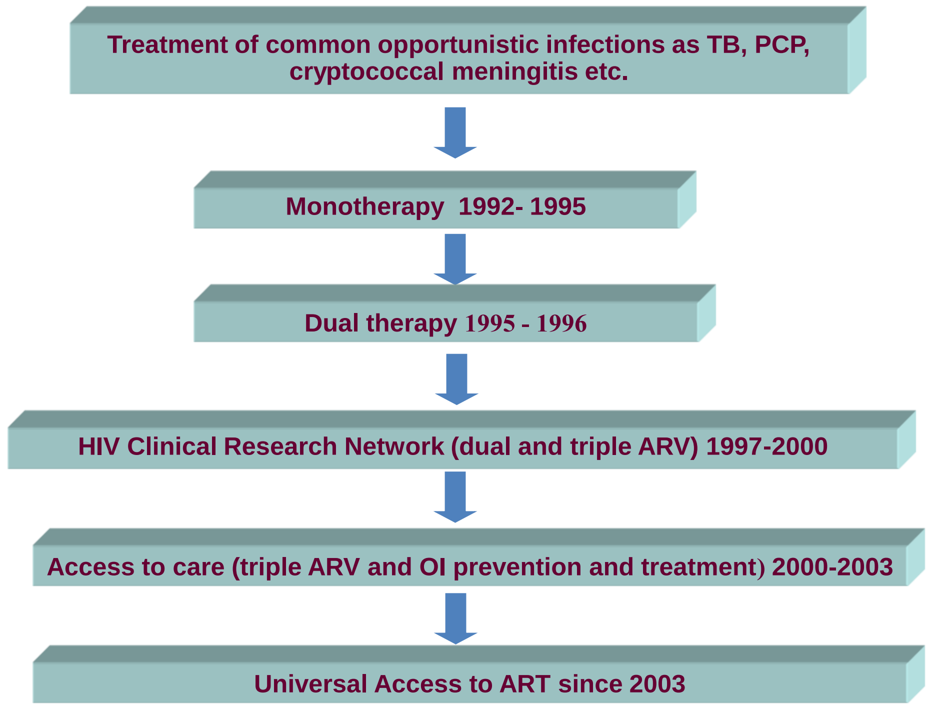
All health care in public hospitals is under the administration of the Office of the Permanent Secretariat (except in Bangkok where healthcare providers are under the administration of the Bangkok Metropolitan Administration). However, they deliver ART services in collaboration with multiple stakeholders, including the Department of Disease Control, which is responsible for providing technical support for the ART service, and the National Health Security Office, which provides financial resources to procure and distribute drugs, and laboratory technicians to hospitals. At the regional level, 12 offices represent the Department of Disease Control and the National Health Security Office. Each regional office has seven or eight provinces under their supervision and coordination. The regional offices work closely with the Provincial Health Offices and hospitals in those regions.

Figure 1.7 Facility levels in the Thai healthcare system



In 2003, the Thai government, in line with its universal coverage (UC) policy, implemented universal access to ART services. The total expenditure on the HIV/AIDS programme was 2.7% of total health expenditure, and it was financed mainly (83%) from public resources. 70% of the HIV/AIDS programme budget was allocated to ART treatment and care (Ministry of Public Health 2010c). The government began developing the ART programme in research clinics in 1992 (Panupak 2004) and expanded it nationally as part of the programme of access to care; Figure 1.8.

Figure 1.8 Progression of the ART programme in Thailand



Thailand has responded to the HIV/AIDS epidemic which is a significant burden on the country. Several strategies, for either prevention or treatment programmes, have been implemented. One of them is the implementation of universal access to healthcare, which by providing ART to pregnant women since 2000, prevented the transmission of HIV to their babies; this was extended to spouses by 2004. In 2007, this programme reached a coverage of 95.90% of all pregnancies,which contributed to the reduction of the vertical transmission rate from 33% in 1999 to 5.4% in 2006,and 1% in 2008 (Ministry of Public Health 2008b; 2010c).

The other key strategy is the implementation of UA to ART. The success of antiretroviral treatment has led to a decrease in hospital admissions and the use of accident and emergency services (Chasombat et al. 2006; Chasombat et al. 2009; Ministry of Public Health 2010c; Panupak 2004; Ruxrungtham et al. 2004; Vassvid et al. 2004). The projection of the AEM in 2008 (Thai working group on HIV/AIDS 2008) shows that there are over 250,000 Thai people who live with HIV/AIDS and are currently deemed eligible for treatment, according to the CD4 level 200 cell/mm^3 or less criterion, demonstrating the success of ART by the downward trend in numbers of PLHIV. 181,003 adults and 8,305 children have received the drugs as part of the national ART programme: 75% of the estimated target population (Adults 72%, Children 78%), (National Health Security Office 2011).

1.2.2 The health workforce situation and its implications, in response to the ART services

Chronic under-investment in human resources for health is a well-established fact (Joint Learning Initiative 2004); in the last two decades recruitment has been frozen in some of the world's poorest countries, mostly in sub-Saharan Africa. Salaries and public budgets have been restricted, often depleting work environments of basic supplies, drugs and facilities. The United Nations has initiated the border development compact in fragile countries, particularly those in sub-Saharan Africa, to help reach the MDGs by 2015 (Joint Learning Initiative 2004).

It is estimated that there are over 100 million people in the global health workforce (Crisp and Chen 2014; Joint Learning Initiative 2004). The minimum threshold for health worker density is 2.5 workers per thousand people[6] (Joint Learning Initiative 2004; World Health Organization 1998). 2.5 billion people, in fifty seven countries, live below this minimum threshold. Out of 186 countries, 45 low-density high-mortality countries are in sub-Saharan Africa, and 30 other low density countries are in Asia and Latin America. There are 42 moderate density countries, 34 high-density low-mortality countries and the remaining 35 high density countries are traditional economies or exporters of medical personnel (Crisp and Chen 2014; Joint Learning Initiative 2004). There is a global shortage of more than four million health workers (Joint Learning Initiative 2004).

In the current HRH decade, 2006-2015 the WHO (World Health Organization 2005), recognises that the shortage of health workers-the global HRH crisis-constrains the achievement of the three health-related MDGs[7], which are to reduce child mortality, improve maternal health, and combat HIV/AIDS and other diseases.

Another challenge is the skill-imbalance which is found in many countries. Mal-distribution is a main problem worldwide, worsened by unplanned migration, with the consequent loss of nurses and doctors. The concentration of workers in urban areas is a worldwide problem (Crisp and Chen 2014; Joint Learning Initiative 2004; Schofield 2012). The WHO estimates that four million additional doctors, nurses, midwives and other healthcare workers are needed (World Health Organization 2006g). In 2004 there

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[6] One of the global health indicators clustered by the Joint Learning Initiative with data compiled from the database estimate of health personnel: physicains, nurses, midwives, dentists and pharmacists, produced by theDepartment of Human Resource for Health, World Health Organization.

[7] The United Nations Millennium Development Goals are eight goals that all 191 UN member states have agreed to try to achieve by the year 2015. The United Nations Millennium Declaration, signed in September 2000 commits world leaders to combat poverty, hunger, disease, illiteracy, environmental degradation, and discrimination against women. The MDGs are derived from this declaration, and all have specific targets and indicators.

were 9.2 million doctors and 18.1 million nurses worldwide (Joint Learning Initiative 2004). Ratios of doctors, nurses and managerial staff, and their skill mixes, vary among different countries (Crisp and Chen 2014; World Health Organization 2006f).

Several causes of this insufficiency are indicated: there are not enough health workers and those there are do not have the right skills and support networks. Moreover, they are overstretched and overstressed and not present where they are needed. The Joint Learning Initiative reported three major causes of the crisis: the devastation of HIV/AIDS increasing the workload (World Health Organization 2006g), an accelerating migration of doctors and nurses (World Health Organization 2005a), and under investment in human resources over two decades (Joint Learning Initiative 2004b).

The inadequate number of healthcare workers face the pressure of increasing services required by the epidemiological profile and the restructuring of healthcare systems. Healthcare workers may also work under unsatisfactory conditions for inadequate incomes. This is demonstrated among healthcare workers in sub-Saharan countries, who are migrating to work in higher income countries such as South Africa (Connell 2010; Joint Learning Initiative 2004; Schneider et al. 2006a). These studies showed that there were more Malawian doctors in South Africa than in Malawi. Among 600 Zambian doctors in training, only 50 continued their work in Zambia (World Health Organization 2005).

Further, ramping up the crisis situation, investment and spending patterns of human resources are inefficient. In some countries, investment in human resources was moved to fund the scaling up of ART and preventative care. Sub-Saharan countries invest about 10% of the total budgets for HIV/AIDS alleviation on human resources (Joint Learning Initiative 2004; World Health Organization 2004a). With particular reference to the focus of this study, the necessary response to the HIV/AIDS epidemic has massively increased the workload of the health workforce. The 57 countries which fall below the density threshold[8] are defined as having a critical shortage (Joint Learning Initiative 2004a), 36% of these are in sub-Saharan Africa. This alarming shortage was approximated as 4.3 million doctors and nurses, presenting a shortfall of 15% of the total numbers of these two professions, globally. The USA, with 4% of the world's population, has 8% of the world's doctors and 17% of the world's nurses. This presents a nurse-to-doctor ratio of 4:1, while India and China have a ratio of about 1:1 (Crisp and Chen 2014; World Health Organization 2006f).

The policy of UA has increased the demands on the health workforce to deliver ART services. At the same time theyhave to comply with other demands on the healthcare service under UC. Many countries are confronted with the problems the ART programme has directly imposed on an over-burdened healthcare system, including health worker shortages, the management of a centralised programme which is not integrated into other services in the health system, structural barriers such as human rights violations, and gender inequality. These effects are seen dramatically in Asia, the Middle East and North Africa (Assefa et al. 2010; Barnigausen et al. 2007; Dussault and Dubois 2003; Joint Learning Initiative 2004; Wadee and Khan 2008; World Health Organization 2004a; 2008c). All these challenges may continue to result in inequitable access to care and treatment for key populations, unless collaborative action is implemented.

[8] Research around the world suggests that a density of about 1.5 workers per 1,000 people is associated with 80% coverage of measles immunisation, and 2.5 workers per 1,000 people with 80% coverage of birth with skilled attendants (Joint Learning Initiative 2004)

1.2.3 Human resource planning in Thailand

Balancing the demand and supply of health workers is the main task of human resource planning (HRP) and management (HRM), which have had to adapt due to the burden imposed on the healthcare system by the advent of HIV/AIDS and the ART programme; the additional demand has had a direct effect on the supply and cost of human resources.

In more detail, a balance is necessary between a product and the process of its planning. Planners and decision makers control the link between policy makers and practitioners. The remit of health workforce planners can be categorised under three major headings: monitorial, advisory and liaisonal (Hall 1998). The monitorial function is to establish, maintain and monitor health workforce databases, covering size, numbers, composition and categories; the advisory function allows health authorities to control and facilitate estimations and projections of staffing and staff training requirements; the liaison function connects the various elements of the healthcare system (Hall 1998).

HRP conducts two main activities: 1) a review of the development and methods of health manpower studies, and 2) recommending future lines of research to the WHO (World Health Organization 1971). The next study by the WHO was conducted in 1973, in the belief that consumers were actually receiving poorer healthcare services than when the WHO was created 25 years earlier, because of a failure of planning of both healthcare services and health workforce (World Health Organization 1973).

A number of reasons were indicated globally, including lack of the necessary personnel: for example, over half the sanitation personnel trained for environmental programmes were lost due to the emigration of graduates; political issues prevented the provision of rural community healthcare workers; there were imbalances in the training budget for some types of healthcare providers; and many established and pivotal physicians also emigrated (Hall and Mejia 1978). Evidence for the need for more healthcare providers in Thailand has been identified in the following study: (Jirawattanapisal et al. 2010) and in other countries, worldwide, in these studies (Joint United Nations Programme on HIV/AIDS 2010; Shisana et al. 2002; World Health Organization 2006b; World Health Organization 2006f), especially in sub-Saharan Africa (Caroline 2003; Tawfik and Stephen 2003); South Africa (Daviaud and Chopra 2008; de Wet et al. 2011; George et al. 2010; Steyn et al. 2009a; United Nation 2001; Van Damme et al. 2008; Van Rensburg et al. 2008; Wouters et al. 2010), Zambia (Dieleman et al. 2007; Hanefeld and Masheke 2009; Torpey et al. 2008), Malawi (Muula et al. 2007), Kenya (Chiambe et al. 2009; Ritzenthaler 2005), Uganda (Chang et al. 2008), Liberia (Rowe et al. 2010), Rwanda and Ghana (Ritzenthaler 2005).

In Thailand, health workforce planning has been integrated into part of the National Economic and Social Development process for over four decades. The latest development is a strategic plan for the decade of National Human Resources for Health Development in Thailand: 2007 to 2016 (The National Human Resources for Health Strategic Plan Committee 2007). Health workforce planning has been conducted independently in issue- and organizational-specific parameters. The Ministry of Public Health is responsible for managing the plan for human resources for health in the country, together with the Bureau of Strategic Planning (The National Human Resources for Health Strategic Plan Committee 2007).

The HRH management in Thailand has four components: planning, production, implementation, and the management and information system, all of which have different lines of command. The central organisations of the Ministry of Public Health are responsible for planning and production; the Bureau of Health Policy and Strategy, and the Praboromrajachanok Institute, are responsible for health and manpower development, respectively. However, no specific organisations or institutes take overall responsibility for the components of implementation, or the management and information system; these two components have been managed by the interest of the professional institutes and users in multiple organisations at multiple levels.

The implementation of managed planning has made positive contributions to the healthcare system and human resources for health situations. The relevant professions such as doctors, dentists, pharmacists, etc, are produced cost-effectively. The production and deployment plan was undertaken without the influence of market forces. The numbers of physicians and other type of specialists has increased, relative to the population. However, there was still a shortage of medical doctors in rural areas. Planning for human resources for health had to be introduced under these circumstances.

The other impact of the implementation of human resource planning in Thailand was an increase in the production of the required and most widely used types of healthcare providers, such as professional nurses. Part of this production plan was to deploy students to their home locality. Community healthcare workers who had been working as auxiliary healthcare providers were promoted as part of the increased production and sent to their communities to deliver a preventive and promotive programme of healthcare service (Pachanee and Wibulpolprasert 2006).

A study of Noree and et al (2005) suggests that the government should be able to scale up output quickly at 50 nursing colleges and 15 medical schools, both public and private, without having to build new colleges. Standards, especially relating to the numbers and quality of teaching staff, need to be very carefully prepared. It was suggested that this increase in production should be based on rural recruitment, local training, and hometown placement concepts, in order to ensure higher retention in rural areas.

Thailand therefore increased the number of medical doctors, nurses, and healthcare providers with a special focus on rural recruitment, local training, and hometown placement; this was known as the ‘One District, One Doctor’ program (Noree et al. 2005). Among the educational strategies, the recruitment of local and rural trainees, to be trained in their local rural health facilities and placed locally after graduation, has tackled mal-distribution, successfully recruiting nurses and paramedics to under-staffed facilities. This strategy, ‘The Collaborative Project to Increase Production of Rural Doctors’ (CIPRD), which includes a compulsory three years of public work, has been in place since 1974 and has produced an additional 700 doctors a year since 1995, increased from 300 per year in 1974 (Noree et al. 2005; Wibulpolprasert and Pengpaibon 2003).

Major challenges to human resource planning are changes in local and globalcircumstances. Health problems, either communicable diseases such as HIV/AIDS, or non-communicable illnesses, have required the management of human resources for health to be changed, adapting to the need for updated roles for existing healthcare providers and the training of new types of personnel. HRH planning should be considered carefully to optimise benefits and ensure effectiveness.

The Thai government is responsible for managing the healthcare system to meet health service goals; the numbers, distribution (availability), competency, performance and quality of HRH. The changes in the environment of the country have affected the healthcare service and its workforce, under such headings as healthcare policy, international trade policy, economics, socio-cultural and demographic transition.

The growth in economic status after 1997 and the international free trade policy led to a dramatic migration of health workers from the public to the private sector. Collaborations began between local authorities and healthcare providers in local communities as well as in relation to the recruitment, planning, and employment of health workers. There have also been considerable developments in the roles and responsibilities of healthcare providers and stakeholders, including the public and private sectors involved in the changes in the Thai health system, since the changes in healthcare policy emphasised the effectiveness of healthcare promotion and prevention in local communities.

Lastly, increases in healthcare services, derived from the introduction ofthe universal coverage policy for many healthcare services including HIV/AIDS, and developments in the treatment of conditions associated with aging and for patients suffering from chronic illnesses, have added to the burden onthe health workforce (Noree et al. 2005; The National Human Resources for Health Strategic Plan Committee 2007; Wibulpolprasert 1999a; Wibulpolprasert 2002). To implement its plan for the health workforce, the government still needs proper solutions to its existing problems, such as inequity in distribution, shortages, inappropriate environments and support systems, lack of an effective mechanism to develop and implement the health workforce policy, a mismatch between health workforce needsand production, and an inadequate knowledge and information system (Noree et al. 2005; the National Human Resources for Health Strategic Plan Committee 2007; Wibulpolprasert 2002).

The problem of inequity in distribution, or mal-distribution, has not yet been solved; the ratio of doctors, dentists, nurses and pharmacists to population in the capital Bangkok in 2002 was between 5 and 10 times higher than that in the Northeastern region. In rural areas (Ministry of Public Health 2002; 2004; 2010b), the shortage of doctors was severe (Noree et al. 2005; Pachanee and Wibulpolprasert 2006; Suwannakij et al. 1998; the National Human Resources for Health Strategic Plan Committee 2007; Wibulpolprasert et al. 1997; Wibulpolprasert 1999a; 2002; Wibulpolprasert and Pengpaibon 2003).

Another significant problem was shortages in the health workforce. The main reasons for these shortages were an increase in the demand of healthcare services, together with a high turnover rate among staff (Jindawatta 2006). For instance, the introduction of UA to ART policy, the emergence of SARS (Ministry of Public Health 2005), and the government policy of promoting medical hubs, all generated an increase in the health workforce requirement, adding to the problem of staff shortages. For example, in 2006, an estimation determined that 3,100 to 5,146 doctors would be needed to provide healthcare services for foreign patients alone, while the total number of available doctors to provide all healthcare services across the country (Wibulpolprasert 2006).

A third problem concerns the inappropriate support system and working environment; for example, non-financial incentives (opportunities to continue education, training and development, and receive social recognition), financial incentives, and the development of infrastructure, were not appropriate (Wibulpolprasert 1999b).

The Ministry of Public Health has implemented policies designed to retain staff in rural areas, as well as providing financial incentives, but this has only been successful in some areas, not all (Boonnha 2005; Lexomboon 2004; Thammarangsri 2004a; Thammarangsri 2005b).

The next problem is the lack of a mechanism to develop and implement the health workforce policy. There are many stakeholders involved in this issue besides the Ministry of Public Health, including non-health ministries, private health facilities, education sectors, professional bodies, local administrative organisations and other groups of people. There is a need of cooperation among all these agencies to agree on policy and vision in order to develop plans, and monitor and evaluate them in order to continuously develop health workforce systems (Wibulpolprasert 2006).

The fifth problem of the health workforce is the mismatch between planning and production, due to staff shortages and an imbalance between supply and demand; demand being higher than supply (Ministry of Public Health 2004). However, some attempts to remedy the situation were successful: nurses, following the health workforce strategy, were trained at local colleges and recruited locally. These graduates then worked in their home provinces and had a high retention rate, which responded to the production plan to alleviate the problem of maldistribution following graduation (Jindawattana et al. 1998). This policy and strategy was also applied to the training of doctors in rural areas; subsequent evaluation found that 68% of these trained doctors were still working at rural district hospitals (Wibulpolprasert and Pengpaibon 2003).

The last problem indicated was an inadequate knowledge and information system, meaning there was not enough information to support decision making. The main reasons for this were the problems of data management of HRH information, and the data base. This indicated inconsistency and lack of the linkage in the data, and in the information, knowledge and skills among many members of the health workforce. 15 organisations cooperated to conduct a study to respond to the problems of data management (Thammarangsri 2004b).

Solutions to the problems of the Thai health workforce required the commitment and participation of all involved stakeholders, following the agreement of the contribution of the national strategic plan for the health workforce. The National Human Resources for Health and Strategic Plan Committee, which comprised all involved stakeholders, established five strategies to achieve the national aims for the health workforce in terms of numbers, skills and equitable and appropriate distribution, from 2007 to 2016. These strategies were: 1) establish and develop a mechanism to set up the National Human Resource for Health Policy and Strategic Plan, 2) re-orient the HRH production and development system, 3) re-orient the HRH management system, 4) generate and manage knowledge and link evidence-based information to HRH policy development and 5) strengthen and empower the roles of community health workers and civil society (The National Human Resources for Health Strategic Plan Committee 2007).

Thai Health workforce planning has been conducted by the Ministry of Public Health, together with the Bureau of Strategic Planning (The National Human Resources for Health Strategic Plan Committee 2007). The four components of Thai HRH: planning, production, implementation, and management of the information system, have different lines of command. Thai HRH has been faced with inequity in distribution, or mal-distribution, as have other countries. Government strategies have solved many of the problems; however, mal-distribution and staff shortages are still challenges.

1.3 SPECIFIC FOCUS OF THIS THESIS

The specific focus of this study is in the area of ART service and its implications for the health workforce in Thailand. From this focus, three main factors confronted the healthcare system, which in turn impacted on ART services.

Firstly, the changes in protocol to the enrollment criteria, which aimed at increasing access and coverage, increasing the number of users, has forced the healthcare system to absorb the increasing need for ART services among PLHIV (Harris 2013; Joint United Nations Programme on HIV/AIDS 2011; 2012; 2013; Ministry of Public Health 2008b; 2010c; World Health Organization 2010a, b). This change of the enrolment criterion, which means PLHIV are enrolled in the ART programme earlier, when their CD4 count (the marker of HIV progression) is still at a relatively high level: about 350 cell/mm^3, from the previous level of 200 cell/mm^3, was implemented by the Thai government in 2011, on the recommendation of the global community for HIV/AIDS (National Health Security Office 2011a). This immediately increased the numbers of PLHIV requiring ART services. The challenge to the healthcare system was to deliver this increase in services while maintaining and improving their effectiveness (National Health Security Office 2011a; World Health Organization 2010a, 2013).

Secondly, also having an effect on HRH is the universal coverage (UC) policy which began in 2001 (Health Systems Research Institute and Ministry of Public Health 2012; Pachanee and Wibulpolprasert 2006; Vassvid et al. 2004) with the aim of allowing equality of access to healthcare services. The ART service was included in the UC policy in 2003 (Global Health Work Force Alliance and World Health Organization 2010; Health Systems Research Institute and Ministry of Public Health 2012;

International HIV and AIDS Charity (AVERTing HIV and AIDS) 2012c; Ministry of Public Health 2010c; Pachanee and Wibulpolprasert 2006; Vassvid et al. 2004).

Under the UC policy, the ART service aimed to cover all PLHIV in the country, increasing the demands on the health workforce. ART services are a life-long requirement for PLHIV and the survival rate is steadily increasing (Health Organization and Joint United Nations Programme on HIV/AIDS 2010; Health Organization and Joint United Nations Programme on HIV/AIDS 2013; McCoy et al. 2005; Schneider et al. 2006a).

Thirdly, a major change to the level of facilities in the healthcare system was made in 2010: the Ministry of Public Health restructured community health centres across the country, turning them into sub-district hospitals, in order to provide healthcare services at the community level (Klinbuayam 2012; Ministry of Public Health 2010a). 9,762 health centres were reclassified in this way (Ministry of Public Health 2010a). These sub-district hospitals were designed to function in the same way as hospitals at a higher level of care, but to be nearer to communities and families. Treatment for chronic diseases such as diabetes and hypertension was transferred to these sub-district hospitals; because HIV/AIDS is considered as a chronic disease (Klinbuayam 2012; Ministry of Public Health 2010a). The queries for study have arised. What the ART model would look like, what types of healthcare providers would be needed to deliver it, what the demands and availabilities of this human resource would be. Moreover, what changes there would be in the provision of the ART services moved from a district hospital, Sanpatong District hospital, located in Chiang Mai province, to all 18 sub-district hospitals in the Sanpatong district (Klinbuayam 2012; Benjakullaya 2012; Klinbuayam 2012; Sithisak 2012; Somrin 2012; Thakumta 2012).

The change in administrative location will have a bearing on health system infrastructure and management. The sub-district hospitals changed their infrastructure by modification from healthcare centres and healthcare workers of those healthcare centres still worked there but changed to be new position relevant to the policy of primary healthcare. There are at least three healthcare workers; nurses, and other community healthcare worker (Ministry of Public Health 2010a).The policy of primary health care (Benjakullaya 2012; Klinbuayam 2012; Sithisak 2012; Somrin 2012; Thakumta 2012), indicates that primary healthcare is an essential part of a practical healthcare system, because it is the first point of contact for individuals and families (Abel-Smith 1994).

This study attempts to map the three major changes; 1) the increasing demand resulting from the policy of universal access to the ART programme, 2) a policy change within the ART programme, which will increase the numbers of PLHIV receiving ART by initiating treatment at an earlier stage, when CD4 count is 350 cell/mm^3, and 3) the decentralisation of healthcare and the change in workforce organisation and mobilisation; all of which directly affect HRH planning and management and ART services.

Having mapped these changes as significant factors in ART services which are having effects on the health system as a whole, in particular HRH, the next step was to define the workforce needed for ART services: step two of the methodology of an integrated workforce those newly infected with HIV and deaths due to AIDS, 2001-2012 (National Health Service 2012). Figure 1.9 demonstrates the six steps used for integrating workforce planning, which is the principle.

Figure 1.9 The six-steps methodology for integrated workforce planning

Source: National Health Service (NHS), UK National Health Service 2012

The Thai government has used a vertical programme or top-down approach to make universal access a part of the ART service. However, they did not provide for the additional human resources for health needed to deliver these services in the existing healthcare system. A significant challenge in making ART universally available is the way decisions are made and the programme managed.

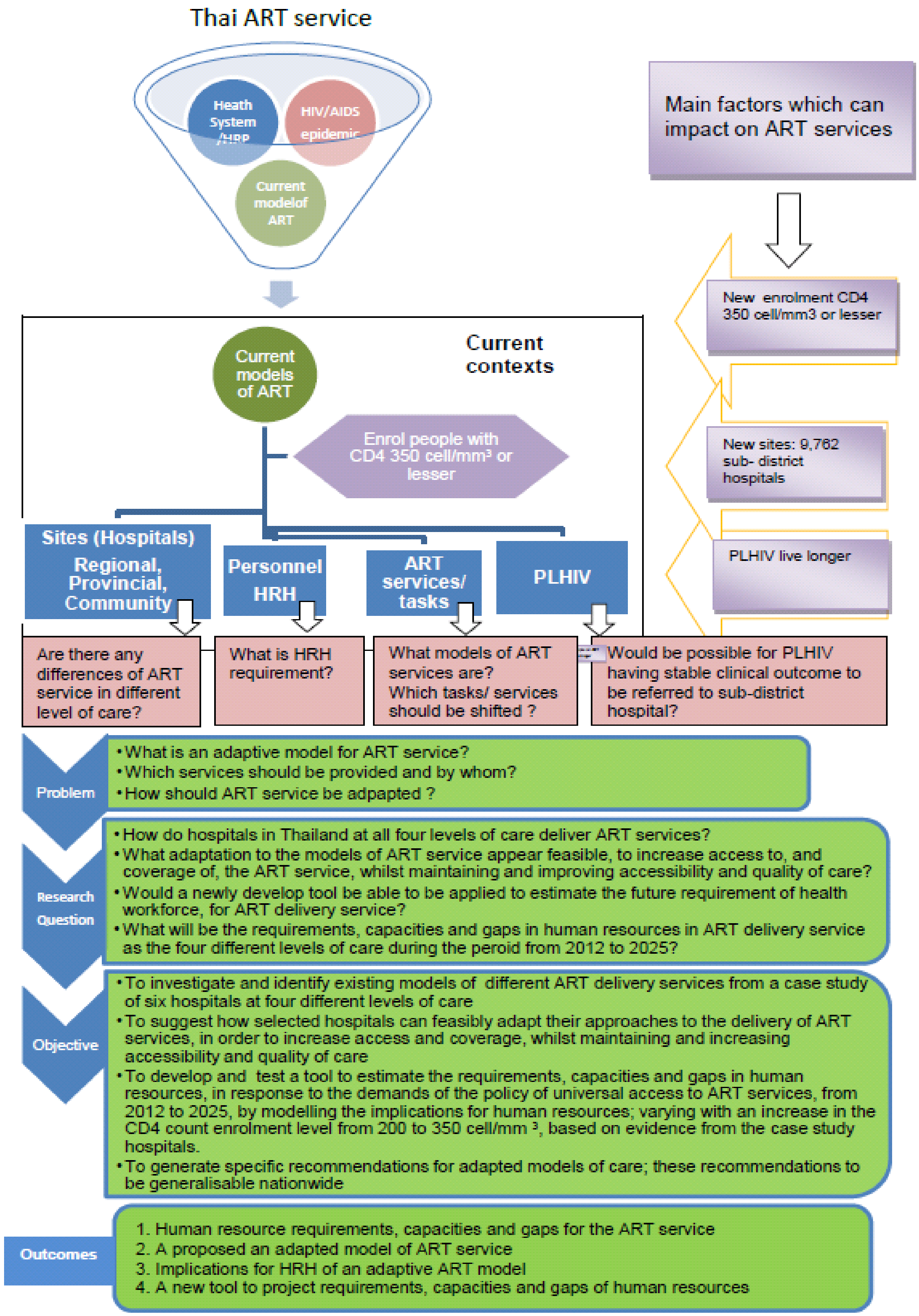
There is a need for a comprehensive analysis of the current requirements of HRH, especially to ensure the long-term benefits of the ART programme, after mapping the changes (National Health Service 2012) generated by the provision of ART and the decentralisation of the health system. It is really important to identify and understand the existing models of ART services, from primary health care to sub-district hospitals, in order to better inform policy makers and allow information about best practice to be disseminated; fieldwork study in the hospitals will enable this.

Another step in healthcare workforce planning is deliniating the numbers and categories of personnel required by the health workforce, and their availability; these are the main queries in my research. Its aims were to find and analyse evidence of the implications for the health workforce of the existing ART services among the four levels of care facilities, and produce policy recommendations, as presented in the last step of the methodology of workforce planning for policy: Figure 1.8; integrating the workforce, developing an action plan and implementing, monitoring and refreshing (National Health Service, 2012).

The changes in the healthcare system, specifically with regard to the workforce, resulting from these three factors, as described in Section 1.2, prompted me to use situation analysis to find out the implications for the health workforce, the active element in the healthcare system, which manages passive resources such as drugs and medical devices, as well as providing healthcare services, in order to deliver the fundamental goal of healthcare: human health (World Health Organization 2010e).

Figure 1.10 demonstrates the conceptual framework of this study research. The background and rationale of the study is based on the foundations of three major changes to the ART programme, two of which directly increase demand on ART services: the policy of universal access and the new enrolment guideline, which specifies a higher CD4 count than that which previously allowed PLHIV access to ART. The other factor is the policy of decentralisation: 9,762 sub-district hospitals, located in the communities they serve, are now authorised to divide healthcare services with hospitals at higher levels of care (Ministry of Public Health 2010b).

Figure 1.10 The conceptual framework of the study research



1.4 AIMS AND OBJECTIVES

The thesis aims to examine Thai existing ART services delivery models at hospitals with different levels of facilities, care and services, and to develop a tool to estimate the health workforce required to provide ART services at those hospitals. Specific objectives are indicated as follows.

Research objectives

1. To investigate and identify existing models of different ART delivery services from a case study of six hospitals at four different levels of care.

2. To suggest how selected hospitals can feasibly adapt their approaches to the delivery of ART services, in order to increase access and coverage, whilst maintaining and increasing accessibility and quality of care.

3. To develop and test a tool to estimate the requirements, capacities and gaps in human resources, in response to the demands of the policy of universal access to ART services, from 2012 to 2025, by modelling the implications for human resources; varying with an increase in the CD4 count enrolment level from 200 to 350 cell/mm^3, based on evidence from the case study hospitals.

4. To generate specific policy recommendations for adapting models of care; these recommendations to be generalisable nationwide.

Research questions

1. How do hospitals in Thailand, at all four levels of care, deliver ART services?

2. What adaptations to the models of ART service appear to be feasible, to increase access to, and coverage of, ART services, whilst maintaining and improving accessibility and quality of care?

3. Would a newly developed tool be able to be applied to estimate future requirements of the health workforce for ART service delivery?

4. What will be the requirements, capacities and gaps in human resources in the ART delivery service at the four different levels of care during the period from 2012 to 2025?

1.5 THE SIGNIFICANCE OF THE STUDY

ART has enabled longer lives for PLHIV and provided enormous improvements to the alleviation of the problems associated with HIV/AIDS. The global community has set the ART service as a major priority, with a long record of addressing health problems and improving quality of life. This study is a further piece of evidence contributing information about ART services, underpinned by a strong health system perspective. The Thai government has not added extra healthcare providers to the healthcare system, because it was considered to be strong enough to absorb this extra burden. Questions concerning the requirements of the health workforce and deployment patterns of ART services were principal reasons for the study, as was the need to develop a tool to estimate future requirements. Its design was similar to that of action research. However, as well as empirical evidence, the study generated knowledge of history, development, and national plans, including successes, challenges and limitations. All these elements were consolidated in this study, which would be able to contribute to the sharing of knowledge with other countries as well as with global communities. This study is piece of a case study research of Thailand which fulfils research gap in the area of ART service and its implication of HRH.

Many details of the study were very important, especially to Thailand, which made changes through scaling up decentralisation across the country. This study aims to illuminate the perspectives of requirements, capacities and gaps of HRH in ART services by comparing the HRH requirement and their availabilityies, expressed as FTE, for the years between 2012 and 2025, and present alternative models of healthcare services as an evidence base for policy makers in the Ministry of Public Health. The findings would be very useful in workforce planning, and will help the government to plan strategically by maintaining a balance between the demand and supply of HRH in the health workforce. The study aims to estrablish and provide a tool for use by the policy makers of the Thai Ministry of Public Health, and possibly by the wider global community for whom provision of ART services are one of the goals.

1.6 RESEARCH APPROACH

As stated above, this study will identify the gaps in human resource availability, specify an adapted model for the delivery of ART, and establish the human resource requirements of this adaptive model. The research design is based on a multi-phase mixed method (Balnaves and Caputi 2001; Creswell 2014; David and Sutton 2011), a combination of Markov and descriptive analysis of the findings (Silverman 2011).

This study uses the Markov model to illustrate the mutually exclusive health states that a patient commencing ART, with or without complications necessitating a changeregimen, might go through. The likelihood of movement between each state (transitional probability) was determined by using data from a retrospective cohort study in the sampling hospitals (Briggs et al. 2011; Norris 1997). The model was used to quantify the FTE work-time of health care personnel per ART client, using the national standard CD4 enrolment level. The simulation was conducted to model FTE over a 99-year period, to cover the maximum total period over which the whole cohort could reasonably be expected to survive.

Markov analysis was selected because it could be applied to unpredictable transitional states of PLHIV when they receive ART treatment. PLHIV can have their outcomes of treatments in three states; new case, have complication and no complication. The Morkov analysis was applied in Economic study. For intance the study that related to ART treatment, a Thai study on the cost of ART services applied the Markov model (Briggs et al. 2011; Norris 1997) to compare the cost effectiveness of two regimens of ART, when there was uncertainty (a transitional state) between the situations of PLHIV who had received first- and then second-line ARV drug regimens (Maleewong et al. 2008).

My study focuses on healthcare providers at the HIV clinics in each of the sampled public hospitals: doctors, nurses, pharmacists, counsellors and laboratory technicians; however, all groups who provided ART services during the field work study were included. Full details of the research design, including details of the sampling hospitals are given in Chapter 3: Methodology.

In the final interpretation of this study, the lessons learned from these case studies are reported, comparing the times required for delivering ART with enrolment at CD4 350 cell/mm^3 or less (the new guideline), with those required to deliver it with enrollment at CD4 at 200 cell/mm^3 or less, the guideline previously followed. The results suggest an FTE requirement higher than that which is feasible or currently available in Thailand. Data from the questionnaire was interpreted to provide supporting information about alternative models of ART employing task-shifting. This data interpretation process was very important because it was the link between the research and policy processes.

This study explored a problem-solving model using empirical evidence to suggest policy actions (Walt 1994). After data interpretation, the information in the study can be an evidence base for this process. The information can be used in direct or diffused ways. The findings of the study will be published to a meeting of the research institute working for the Ministry of Public Health[9], which is the process for feeding research into the policy-making process, the beginning of policy agenda-setting.

There are many different tools for estimating the number of staff required to provide health services, some of which have been applied by this study, such as part of the workload indicators of staffing need (WISN) tool (World Health Organization 2009; World Health Organization 2010g), and using a workload rationale to calculate staff need (World Health Organization 2008a) which underpins some of the different approaches of HRP. This approach has many desirable features and is based on demand to determine requirements and gaps (Dreesch et al. 2005; Mcquide et al. 2008; World Health Organization 2010d).

[9] A meeting of the research institute composed of multi-stakeholders in the AIDS network; Department of Disease Control, National Health Security Office, Social Security Office, NGOs, AIDS experts, experts in the health system.

One study has applied WISN to calculate the requirements for health staff in 12 primary health care facilities in one sub-district in South Africa, each of which included ART services (Daviaud and Chopra 2008). This study suggested a possible HRP method. However, this study modified the WISN method, which originally presented limitations when predicting changes to demand for services.

Another study which seemed to have aspects in common with my area of interest was a study of health professionals providing ART services in Zambia and Mozambique (Smith 2005). The basic calculation in this study multiplied the number of patients receiving care by the time taken for service delivery per patient, and divided this by the amount of time that each health worker could spend seeing patients in a year. The calculations of this study were similar to those of two previous studies (Jirawattanapisal 2009; Jirawattanapisal et al. 2010). However, the treatment outcomes of PLHIV have three transitional probabilities. The simple calculation could not be applied for the best fit of this characteristic of PLHIV, but the Markov analysis could, as the rationale of its discrete and time-motion study, undergoing a random process transition from one state to other state.

Definitions of terms used in this research

There are eleven principal clinical terms used in this thesis.

1. Follow-up without complications: the health status of PLHIV who show a stable clinical outcome to treatment, at appointments for checking their health status and the outcome of ART.

2. Follow-up with complications:

The health status of PLHIV who show complicated clinical outcomes to treatment at appointments for checking their health status and the outcome of ART. The complications may include adverse drug reactions (acute or chronic), resistance to ARV drugs, sickness or other symptoms that PLHIV may face, leading to a non-normal health status, such as fever, food poisoning, abscesses etc.

3. Loss to follow-up: PLHIV who have not kept appointments to follow up the outcome of ART, and who healthcare providers have usually tried to contact, without success.

4. An adapted ART model: an existing ART service delivered in the hospitals studied in this research which differentiates from the national guideline and recommendation of ART service in Thailand.

5. Demand: a measure of requirement of ART services that PLHIV will want to access. The demand can be applied in the health workforce; however, the demand does not carry all the implications of health workforce, but specifically on the services.

6. Requirement: amount of ART services, and the manpower required to satisfy a given set of assumptions about how the health sector functions.

7. Need: anestimation, based on a required number of healthcare workers or ART services.

8. Supply: the availability and characteristics of human resources at a given time, or at a future time, according to specified assumptions about production, losses and use.

9. Health workforce or healthcare worker or healthcare provider: a health worker who offers ART services in order to improve the health of a PLHIV.

10. Communityhealthcare worker: healthcare worker who provides ARTservices at the community level.

11. Volunteer: non-healthcare worker who volunteers to help healthcare providers to deliver ART services.

1.7 THESIS OUTLINE

In Chapter 1, this study begins with the background to the thesis: the origins and impacts of the HIV/AIDS disease, and the global response to alleviate them. The prevalence of the HIV/AIDS problem, the increase in demand for ART services, and the limited numbers of healthcare professionals available to deliver this service in many of the worst affected countries, have generated a need to explore existing models of ART delivery, adapted from the national guideline by hospitals; develop a tool to estimate future demand; and suggest a feasible model for ART services to meet this demand effectively.

Thailand is one of the seriously affected countries. The government has provided UA to ART services since 2001, and in 2012 changed the enrolment criteria to these services, making them available to PLHIV who still had a high CD4 level, leading to a major increase in the numbers eligible for treatment. At the same time, the health system was reorganised; sub-district hospital were established, close to communities.

These two changes also added more reasons for investigating the implications of the adapted models.

In detail, this chapter describes the origin and impact of HIV/AIDS, and the global responses to the problem, such as global actions, the setting of priorities, and strong commitment to effective strategies. A further section reviews ART service in global and Thailand. Moreover, health workforce situation and its implications in response to ART services were reviewed. The human resource planning in Thailand was reviewd in the Thai healthcare system, its development and evolution, new trends, the strong multi-sectoral political commitment and leadership which have brought about key successes in the UC and UA to ART policies, and the long-term, continuous investment in health systems and HRH at all levels. The specifc focus of this thesis, aim and objective were indicated followed by the significance of the study, research approach and thesis outline.

Chapter 2, the literature review, presents main areas relating to the foci of the study reviewed from the literature: the UA to ART service contained in the UC policy, and the impact of HIV/AIDS on HRH, especially in the countries already confronting an HRH problem. Moreover, the review of health workforce planning and its implications with regard to ART services were also evidence that many countries applied HR strategies to respond to the ART service. This chapter starts by describing how the provision of UA to ART impacts on HRH in a variety of settings in different countries. This analysis is followed by an examination of how the development of a community approach and the policy of primary health care affects the health workforce. The development of tools to estimate requirement of health workforce was reviewed. The next section is the reviews responses to an increasing demand health workforce to deliver ART services.The literature review presents an adaptive and alternative model for ART services; problems and challenges of the delivery service are described, along with the global and local responses to these challenges.

Chapter 3 describes the framework adopted for the research design and the levels of analysis, and substantiates my methodological and epistemological choices. The explanation of methodology that combines qualitative and quantitative components offered the best approach to investigating the models of ART delivery service and the requirements of the health workforce. The research objectives are explained clearly, in order to link to the research design: a multiphase mixed-method approach. This section also introduces the application of a quantitative and qualitative research approach to the process of data collection, analysis and interpretation. Direct observation could be used for eliciting the time required to provide ART services; moreover, this method is used for task analysis, with a structured interview (data collecting form) which was used for collecting demographical data about the hospitals, and secondary data concerning PLHIV. Open-ended interviews were used to elicit organisation details, and provide an overview of task analysis. For the quantitative approach, there was a need to develop a tool to estimate and project the time which would be required to provide ART services from 2012 to 2025. Markov and MonteCarlo analyses were applied, becausePLHIV could change their treatment outcomes while they were receiving ART.In the last section of this chapter, issues of quality assurance, reliability/validity and ethics are presented.

Chapter 4 presents the findings of the fieldwork study, collected and analysed mainly by a qualitative approach. Task allocations and distributions are analysed and explained; the times required to provide ART services, and their organisation at each hospital, are analysed, according to the particular model employed. Details of each model of ART services among the four different levels of care are comprehensively described and compared. The findings of this chapter indicated four principal aspects which differed among the three models: task allocations, PLHIV characteristics, rate of loss to follow up of PLHIV, and the time required for providers to deliver ART. The two indicators, rate of loss to follow up and change of CD4 level were suited to be used specifically as they were available data in this study-design.

Chapter 5 presents the main findings of the quantitative approach. This chapter starts by presenting the secondary data gathered from the national database and related publications, with details concerning healthcare providers and the numbers of PLHIV receiving ART services. This chapter specifies the input parameters collected from filed sites in Chapter 4 and used to estimate the workforce requirement to provide ART services; the demands, gaps and availability of the health workforce, including the times required to provide each element of ART service by cadre of healthcare professional or non-healthcare worker; and other input-parameters and assumptions, to allow Markov analysis and Monte Carlo analysis, in order to ensure an accurate estimation of the requirements, capacities and gaps in the ART service healthcare workforce.

In Chapter 6, the results and findings from Chapters 4 and 5 are discussed and concluded. The thesis concludes by reflections on its theoretical and substantive contributions to workforce planning methods. A discussion of different aspects of the various ART models, and specific recommendations concerning the implications for HRH and the planning of universal access to ART services. The three models of care responded to the increasing user demands and access requirements in Thailand by applying human resourcestrategies, including task-shifting, skill-mix and the participation of both healthcare and non-healthcare workers in the community. This was similar to other countries with health workforce constraints. By applying the new tool, based on Markov analysis, developed in this study, to estimate and project HR requirements, this study found no gaps in the human resources needed to deliver ART service in the existing healthcare system, while maintaining/increasing accessibility and quality of care.

1.8 CONCLUSION

Thailand has responded to the HIV/AIDS problem by providing UC for ART services. HIV/AIDS has a powerful biological and epidemiological impact, increasing mortality among adults and children. There is also an economic burden making care out of reach for millions of HIV patients, and impoverishing communities. Furthermore, HIV/AIDS impacts on the healthcare system and health workforce. The healthcare systems in many countries has been over stretched and faced with a shortage of health workers and a reduction in coverage and productivity.

All four levels of care within the Thai healthcare system will be using a service-demand approach to workload measurement during site observations: 1) the increased demands on ART services arising from the UA policy, and the necessity of life-long treatment for PLHIV, 2) the change in the eligibility criteria for enrolment to ART services, allowing PLHIV with higher CD4 counts to access the system, and 3) the change of healthcare structure from a decentralised policy to one providing treatment at sub-district hospitals close to the communities being served. The prevalence of HIV/AIDS has increased the demand for treatment services, and exacerbated the scarcity of health workforces, leading to the need to explore the existing models and find a new model of ART delivery service. Moreover, the three changes mentioned above added more reasons to investigate those adapted models of care, by creating a tool, based on Markov analysis, to project staffing needs for use by service planners and managers, and create a stronger evidence base for policy formulation at the national and global level.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

This chapter critiques the literature on the implications of the UA to ART policy on HRH and HRP, the tools to measure the requirement of service providers, from a global and specifically Thai point of view. Section 2.1 explores the first topic of the chapter: universal coverage. Literature concerning the policy of UC is critiqued, with regard to the universal coverage of ART service. Section 2.2 describes and critiques the literature relating to universal access to ART services, both internationally and in Thailand.

Literature concerning the other main focus of the study, human resource planning, is reviewed and critiqued in Section 2.3 presents main issue of human resorce planning. The development of a tool to estimate the requirement of health workforce to deliver ART service is reviewed in Section 2.4.Section 2.5 explains planning of health workforce and strategies responding to an increasing demand health workforce to deliver ART service. Section 2.6 presents the Thai ART service and its implications for the health workforce. Section2.7 concludes this chapter.

Search strategy

The search methodology comprised two components; a literature search of electronic bibliographic databases, and a secondary literature search for statistical data relating specifically to Thailand, which provided most of the data, as few sources were found in the primary search.

The literature search was a web-database-search strategy. It was initially carried out in PubMed and then in CINAHL with full text (via EBSCO host Research Databases) and Google Scholar. Other relevant materials including grey literature research reports, administrative reports, and articles were also reviewed. Publications were requested from the authors, or from other people in the field, and from global community agencies including World Health Organization (WHO) publications and the Joint United Nations Programme on HIV/AIDS (UNAIDS). Some papers were tracked further from references in articles.

I drew my key words and terms from my first draft introductory chapter that indicated the domains of my research. They were terms that occurred frequently and which I judged the important concepts involved. Key words and terms included ART, Antiretroviral therapy, impact of ART, universal coverage, universal access, HIV/AIDS, human resources for health, health workforce, human resources, human resource planning, skill mix and task shifting. All references from selected relevant papers were reviewed by title and abstract to determine their potential relevance to the review. The literature review extended from February 2012 until 31 December 2013. I included all relevant publications, in both English and Thai languages.Papers not related to ART and human resource planning, and/or which were in languages other than English or Thai were excluded from the review. From this preliminary search, approximately 453 papers were initially identified. These were thoroughly reviewed and 333 were judged to be relevant to the thesis objectives.

2.1 UNIVERSAL COVERAGE

The concept of universal health coverage (UC) was established in the World Health Organization (WHO) constitution of 1948 (World Health Organization 1948). Its definition of health was stated in the *Health for All* agenda at the Primary Health Care meeting of the Alma-Ata declaration in 1978 (International Conference on Primary Healthcare 1978; World Health Organization 1978). UC is defined by the WHO thus: “ensuring that all people have access to needed promotive, preventive, curative and rehabilitative health services, of sufficient quality to be effective, while also ensuring that people do not suffer financial hardship when they are paying for these services’’ (World Health Organization 2014a, b, c). From this definition of UC, the three objectives of universal coverage are 1) equity in accessing health care services, which means that people who need the service receive it, whether they can pay for it or not, 2) quality of services, which means that they are qualified to improve the health of people receiving that service, and 3) financial risk protection, which means the cost of using that service will not bring those people the risk of financial burden (World Health Organization 2014a, c).

1) Equity in accessing healthcare services. Committment to equity is at the heart of the UC policy; the risk that the poor would be left behindis a concern. Measuring coverage is important, to ensure access across different sections of the population.

2) Quality of services. To improve quality of service is to maintain service that is good and focus on services that need improvement. Variations of healthcare practice, and under use or over use of services, are challenges for quality improvement.

3) Financial risk protection is the other key component of the UC. This can be measured by identifying incidences of catastrophic and impoverishing expenditure, using a poverty gap indicator.

UC was a markedissue at the World Health Assembly in 2005; Resolution 58.33 stated: “…to plan the transition to universal coverage of their citizens so as to contribute to meeting the needs of the population for health care and improving its quality, to reduce poverty, to attain internationally agreed development goals, including those contained in the United Nations Millennium Declaration, and to achieve health for all’’ (World Health Organization 2005b). This resolution was a global target goal, committed to by all countries participating in the discussions (World Health Organization 2010c).

On the progress towards full UC, many countries reformed their healthcare systems, especially from the financial aspect. For instance, China (Meng and Tang 2010; World Health Organization 2014b) and the USA (Congressional Budget Office 2010; World Health Organization 2014b), two of the most important global economies, have been reforming the finances of healthcare since 2009 and 2010, respectively.

Limitations in responding to the UC policy in some countries were found. The financial reform could not be applied in some countries. The WHO has reported that there are an estimated 150 million people across the world either suffering from a lack of access to health services, or who have to pay for these services from limited budgets, frequently reducing them to poverty (Investopedia 2014a; UHC forward 2014; World Health Organization 2014a, b, c). Some countries had the capacity to tailor their own systems of healthcare finance because they hada different context of healthcare system and economic growth; for instance, in Asia, Thailand, Sri Lanka and Mongolia; in South America, Colombia, Chile, Cuba, Brazil and in Africa, Rwanda and Ghana.

Other countries including the Lao People's Democratic Republic, Vietnam, the Philippines, Gabon and Tunisia, are categorised as having various forms of pre-payment and pooling of budgets; along with 27 other countries of the Organisation for Economic Co-operation and Development (OECD), they cover their health insurances by pooling funds (World Health Organization 2014b).

Countries which achieved universal coverage were Canada and Germany (Investopedia 2014a; Torrey 2014; UHC forward 2014; World Health Organization 2012a; World Health Organization 2014a, b). These countries have provided universal coverage to their whole populations, having the ability to afford the necessary resources under a strong healthcare system, including an adequate workforce. Other countries: Mexico, India and Indonesia had a large scale-up of their healthcare systems. Healthcare system reform was conducted over many years because of high degrees of social inequity. However, they have achieved UC with social protection for all citizens (Frenk 2006; Investopedia 2014a).

According to the criteria that I mentioned above, Thailand launched a UC policy in 2001.The Thai healthcare system has been in the process of reform to achieve UC for the 28 years before 2014, and the development of the healthcare infrastructure and health workforce, which has been in process for over 40 years. The UC policy was launched successfully by the government taking the lead to bring about the long-term affordability of healthcare resources (Health Insurance System Research Office 2012; Patchanee and Wibulpolprasert 2006; Prakongsai 2008).

The government attempted to increase the coverage by increasing the coverage of health insurance. This was achieved in every province by October 2001 (Patchanee and Wibulpolprasert 2006). UC of healthcare for almostthe whole population was achieved by early 2002 (Health Insurance System Research Office 2012). Most of the population gained access health services through three main health insurance schemes:the Civil Servant Medical Benefit Scheme (CSMBS), the Social Security Scheme (SSS), and the Universal Coverage Scheme (30 Baht Scheme); these schemes, plus private health insurance, cover 94.9 % of coverage of health insurance. This leaves 5.1 % of the population uninsured[10] (Patchanee and Wibulpolprasert 2006).

The first government “pro-poor” scheme was established in 1975 in the name of social welfare for the poor. Figure 2.1 shows the evolution in health facilities and the major changes in the healthcare system, an evolution of the re-organization of healthcare facilities and budget shifting. In the early period of this evolution, the government provided the majority of financial support at the higher facility levels, but less at the rural level). This was reversed in later years, when the government invested more in re-organizing at the rural facility level. This argues that one of the key successes in responding to the UC policy is the financial support and investment in re-organization and the decentralised policy.

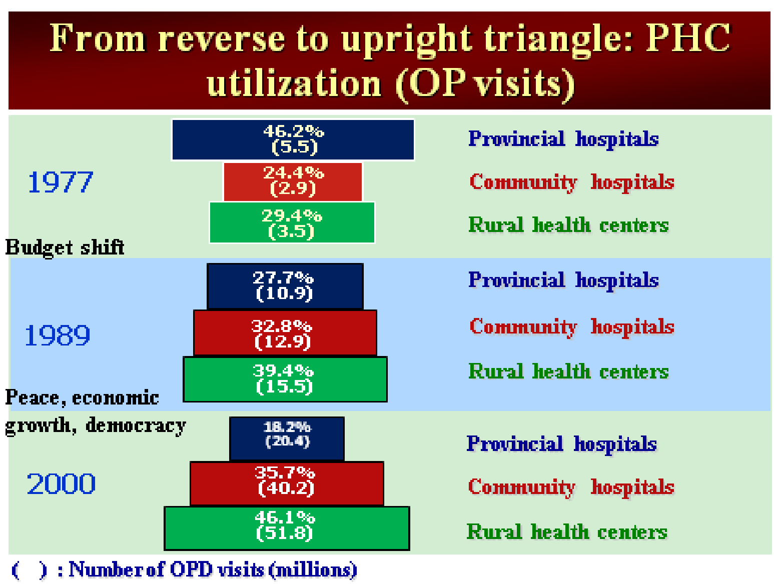
In 1997, Thailand was affected by the global economic crisis, but after the economic recovery in 2001, UC was introduced, being supported across the political spectrum as

[10] The National Health Security Office (NHSO) is the body in charge of universal coverage for the Thai population, covering the 74% of the target population not covered by the other two public schemes: the Civil Servant Medical Beneficiary Scheme (CSMBS), which funds heathcare for government employees (10% of the population) and the Social Security Scheme (SSS), for non-government employees. Both schemes share similar core packages and provide payment methods (Health Insurance System Research Office 2012).

an opportunity to capitalise on the necessity for serious reform. Three major public schemes were established in an attempt to provide healthcare services to all 67 million Thai citizens.

Large-scale investment in the health system at the district and sub-district levels has taken place in the past two decades. This extension of infrastructure was fully supported by the long-term man-power production plan. Typical health centres cover between 5,000 and 50,000 people. The health staff typically comprises 3-5 nurses and paramedics, compared to the higher staffing levels at hospitals, where there are 3-4 physicians, 30 nurses, 2-3 pharmacists and other healthcare workers (Health Systems Research Institute and Ministry of Public Health 2012; Patchanee and Wibulpolprasert 2006; Prakongsai 2008).

Figure 2.1 Health facilities and the re-organisation of the Thai healthcare system



Source: Health Insurance System Research Office 2012

Note: OP refers to out patient: the patient who visits a hospital and goes home

This continuous investment has resulted in universal coverage of basic essential health services since the late 1980s. Rural health infrastructure has been gradually implemented, beginning in the 1950s with the 100% coverage of provincial hospitals, followed by 100% coverage of rural district hospitals and health centres between the late 1970s and late 1980s.However, there were financial problemsin the country in the early 1980s: a serious economic downturn caused by two oil-related shocks (Figure 2.1). However, after 1989 when economic growth improved, the government made changes to the budget to allow more investment in rural areas, until these peripheral healthcare services (PHC) were receiving almost half the healthcare budget. In 2007, healthcare facilities in the rural health infrastructure were completed reorganised, with a system of sub-district hospitals, followed in 2012 by community hospitals and provincial hospitals.

This picture of the government's long-term investment in the Thai healthcare system reflects its strong commitment to healthcare reform, leading to the achievement of UC across the country; supported across the political spectrum as an opportunity to capitalise on the necessity for serious reform,presenting a similar picture to that in many other countries (Investopedia 2014a; UHC forward 2014; World Health Organization 2014a, b, c).

The Thai government has been strongly committed to financial support for the UC policy. However, other countries facing difficult political situations anda variety of financial problems depending on national income levels, failed to provide social welfare and benefit packages for their populations (Prakongsai 2008; World Health Organization 2014b, 2005c).

There are gaps and challenges to the implementation of UC in Thailand, such as inequities in utilisation and spending across the three insurance schemes, and fragmentation of financing (Lindelow et al. 2011). However, there are other challenges, which are not financial but institutional: conflicts and resistance to change, underpinning the contextual factors and micro-political struggles which have appeared at various times.

Separation between provider and purchaser has still not been solved, the reason being that the MOPH and the NHSO each have their own policies and development plans. They are also accountable to different organizations; the NSHO is accountable to the National Security Board, which reports to Parliament, whereas the MOPH is a government ministry. The other challenge is the inequitable distribution of the health workforce. Additional, the management of salaries from the additional money of the UC policy was taken disproportionately by the top levels of care before distribution to the lower service levels. This happened during the ten years of UC development: 2000 to 2010. During this period, the UC budget for salaries was partially undetermined, and there was limited ability to use the UC budget to reallocate the health workforce, because there was no clear policy from the MOPH on the distribution of human resources (Health Insurance System Research Office 2012).

Problems experienced in the implementation of the UC policy illustrated that countries need strong and well managed healthcare systems, in order to provide healthcare services and solve their disease problems; they need to develop and strengthen health system financing to ensure affordability and quality of essential medical care, technology and equipment; and they need sufficient capacity and efficient management of the healthcare workforce (Investopedia 2014a; UHC forward 2014).

To sum up, this section explains the significance and achievement of UC. In Thailand, the government is strongly committed to providing the financial resources to reform and strengthen the UC policy. This has been less successful in some other countries. Implementation of UC has faced challenges of improving quality of care, coverage, and financial risk protection.

2.2 THE UNIVERSAL ACCESS TO ART PROGRAMME

Many healthcare services have been included into UC policy since its global expansion, including the global issues of HIV/AIDS (World Health Organization and Joint United Nation on HIV/AIDS 2010). HIV remains the most serious infectious disease challenge to a variety of organisations, but specifically those concerned with public health, due to the number of new infections and increasing ‘;numbers of PLHIV. Three actions have been advocated to reduce the infection rate and the overall trend: first, broaden the range of benefit programme interventions and efficient services. Second, broaden the universal access approach. Third, provide protection against the social consequences of taking up healthcare (World Health Organization and Joint United Nations on HIV/AIDS 2010). Improvements in access to ART in many regions of the world have slowed the course of HIV infection and prolonged human lives by reducing mortality(World Health Organization 2006a) and morbidity (De Waal and Whiteside 2003; Jahn, A. and et al 2008; Jahn, A. and et al 2008; Ministry of Public Health and World Bank 2004; Ndongko and Oladepo 2003; Stover et al. 2008; World Health Organization 2006a). Governments have to plan how to solve the problems presented by HIV/AIDS using a variety of strategies, in order to allocate available resources where they can do the most good (Joint United Nations Programme on

HIV/AIDS 2012,2013; World Health Organization and Joint United Nations Programme on HIV/AIDS 2011).

The World Health Organization (WHO) set itself the ambitious target of enabling three million PLHIV in low- and middle-income countries (LMIC) access to ART services by 2005; a threefold increase from December 2003. However, this target was not met: only 1.3 million PLHIV were able to receive these services (World Health Organization 2006a, d). A later commitment was made to reach 80% of all PLHIV by 2010 (World Health Organization and Joint United Nations Programme on HIV/AIDS 2010); in 2009, scaling-up access to HIV prevention, treatment and care was made a priority, and two million people, among the five million people receiving ART, were receiving it for the first time, an increase of 34% in a single year. However, in 2013, 15 million PLHIV, eligible for treatment under the new HIV/AIDS treatment guidelines of the World Health Organization, were unable to access it. 91% of all new infections are among children; overall, a 13-fold increase since 2004. However, expanding access to treatment did contribute to a 30% decline in deaths among PLHIV between 2005 and 2013 (Joint United Nations Programme on HIV/AIDS 2013).

In 2011, the Geneva Assembly re-committed to the achievement of the Millennium Development Goals, particularly Goal 6, by 2015[11] (United Nations 2011a; World Health Organization 2011; World Health Organization and Joint United Nations Programme on HIV/AIDS 2011). The global community, under the leadership of the United Nations (United Nations 2011a) established Universal Access (UA) to ART

[11] The goal of universal access is also part of Millennium Development Goal (MDG) 6 which includes the goal of halting and beginning to reverse the spread of HIV/AIDS by 2015.

service by 2015 as a target of the UC policy, which was a part of the Millennium Development Goal (MDG) 6.

'Universal access is achievable. As of December 2009, seven countries had already reached at least 80% of treatment-eligible individuals with antiretroviral treatment. Eighteen countries reported treatment coverage of at least 60% [including Thailand]. Countries are responding to the changes in treatment eligibility criteria specified in the 2010 updated guidelines issued by the World Health Organization, enrolling individuals with a CD4 count below 350. Under the new recommendations, the total number of people eligible for treatment is about 50% higher than under the previous guidelines, which called for treatment to be initiated once a patient's CD4count fell to 200 or below.'

AIDS at 30 Nations at the Crossroads (UNAIDS 2011)

In July 2013, UNAIDS, WHO, the US President's Emergency Plan For AIDS (PEPFAR), the Global Fund to Fight AIDS, Tuberculosis and Malaria, and other partners, gathered to launch 'Treatment 2015' to ensure that the world reaches the 2015 target of universal access to ART. As of December 2012, a total of 10.6 million people were receiving ART, globally, an estimated 9.7 million of whom were living in LMIC, and 0.875 million in high-income countries. Improvements in access to ART in many regions of the world have slowed the course of HIV infection and prolonged human lives by reducing mortality and morbidity. This fact reflects that about 99% of PLHIV live in LMIC with limited access to ART services. This indicates a serious need to strengthen and increase access to ART in these disadvantaged countries. This need to increase access implies an increase in demand, which impacts directly on the ART workforce supply.

Many countries have launched the UA toART service and increased its coverage. For instance, most countries in South and South East Asia reported the achievement of UA to ART services, with many setting a universal access target at over 90%, followed by Western and Central Europe, andSub-Saharan Africa. These countries, however, reported setting the lowest target for UA. This reflects the limitationsof UC for UA to ART, which could not be achieved in some countries due to their healthcare systems (Joint United Nations Programme on HIV/AIDS 2010, 2011).

The expansion was not fast enough to meet the 2010 target for universal access, and the evaluation as of August 2013, based on 15 reports concerning 109 countries, was that they are not on track to meet the target of reaching 15 million people[12] by 2015, indicating the inefficiency and inappropriateness of target-driven approaches. This means that there are still many PLHIV unable to access to ART services. Figure 1.6 shows that there were about 5 million PLHIV accessing the ART service, and about double that not in treatment. This is meaningful to health workforce planning, since all PLHIV should be included in ART services. The numbers of PLHIV reflect directly to the demands on the health workforce.

Challenges of the global response to ART were found; facing financial and technical challenges in achieving the goal of universal access to healthcare, as well as the potential increase in burden from technological developments including drug resistance (necessitating a change from first to second and third lines of drug regimen) and also the factor of migrant workers from neighbouring countries placing an additional burden on the health system. This conclusion raises challenges for future planning which

[12] The international community sets the target for universal access of 80% of those in need receiving treatment to HIV treatment, prevention and care by 2010 and reaching 15 million people by 2015

includes the main resource as the human resource planning. The problem of migrant workers from neighbouring countries is adding up the existing challenges of the health workforce as mal-distribution and shortages; moreover, the plan to respond to the increase in demands of the ART service, both for the countries concerned and the global community. Some of these workers are in the host countries illegally, and are also highly mobile, making the delivery of health services difficult to manage in the database and track them. Moreover, access to health services in many low and middle-income countries (LMICs) is already constrained by under-resourced health systems, and many ART programmes are not well-integrated with other health services. Quality of services also needs long-term investment for sustainability of ART service in saving lives of PLHIV and quality of care (International HIV and AIDS Charity (AVERTing HIV and AIDS) 2012a; 2012c; Joint United Nations Programme on HIV/AIDS 2013; United Nation 2011a; United Nation 2011b). However, it should also be noted that across health systems, scaling up antiretroviral therapy provision presents not only challenges but also opportunities and benefits that extend well beyond the treatment of HIV. In the hyper-endemic settings in which PLHIV have accounted for the bulk of bed occupancy of patients every year, the scaling up of ART is freeing-up health system capacity to address other health priorities.

This section reviews the provision of UA to ART in the UC. The UC aims to help PLHIV access ART services. When PLHIV have more access to ART services, demand will follow in the same direction. An increase in the demand for ART services directly reflects an increase in the requirements of the health workforce.

2.3 HUMAN RESOURCE PLANNING

Human resource planning (HRP) is one of the 25 principal activities of Human Resource Management (HRM), (Foot and Hock 2008a). Specifically, HRP is part of the people-management function, an activity underpinning strategic development (Boxall 1992; World Health Organization 2008b). In HRP, estimation of demand, internal and external supply, existing staff, new recruitment, potential staff and leavers are the basic elements (Boxall and Ritzenthaler 2003; Bratton 2003b).

An obvious element of HRP is to improve the quality of decisions and facilitate the balance of demand and supply of the health workforce. HRP is concerned with types of healthcare workers, skills, work environment, organisation, capacity, performance, distribution and efficiency.

This study is theoretically located in the area of HRP (Dreesch et al. 2005; World Health Organization 2010a). Providing any kind of service needs human resources. This study adopts a service-demand approach HRP: the ART services to be delivered are estimated based on the health needs of the population, and universal access to ART services for all HIV infected patients who are eligible for the standard treatment (Dreesch et al. 2005; World Health Organization 2010a). In estimating the demand for human resources, there is a need to envisage tasks, required skills, how tasks can be grouped and how many people will be required to perform them, by taking a long-term view and working towards the preparation of relevant organizations to cope with future requirements (Bratton 2003a; Foot and Hook 2008; Strike 1995).

This study focuses on the HRP of the expanded ART services. Service expansion relies on management to plan for HRH, using public health norms which have been described within an action framework (World Health Organization 2008b). In this framework, the action cycle of HRH involves action fields in order to succeed; HRM, leadership, partnership, finance, education and policy. Focusing outside these action fields, there are two steps of interest in my study: situation analysis and HRH planning.

The health workforce planning can be viewed from various perspectives. Health workforce planning can be in the short or long term. For short-term planning, a government needs to determine current numbers of staff in each professional area, but increasing the numbers of these healthcare providers can only be achieved in the long-term (Smith 1992).

Problems in the health workforce were found in both developed and developing countries, exhibiting similarities in the inadequacy or virtual non-existence of health workforce planning. This has constrained healthcare systems with such problems as an imbalance in the demand and supply of some types of health personnel, especially for the supply side; inadequate or inappropriate training for a variety of necessary healthcare tasks; and poor correlation of skills and the need for them from a geographical viewpoint (Dreesch et al. 2005; Hall 1998; Hornby 2007; Hornby et al. 1980; Joint Learning Initiative 2004; World Health Organization 2006b).

The remit of health workforce planners can be categorized under three major headings: monitorial, advisory and liaisonal (Hall 1998). The monitorial function is to establish, maintain and monitor health workforce databases, covering size, numbers, composition and categories; the advisory function allows health authorities to control and facilitate estimations and projections of staffing and staff training requirements; the liaison function connects the various elements of the healthcare system (Hall 1998).

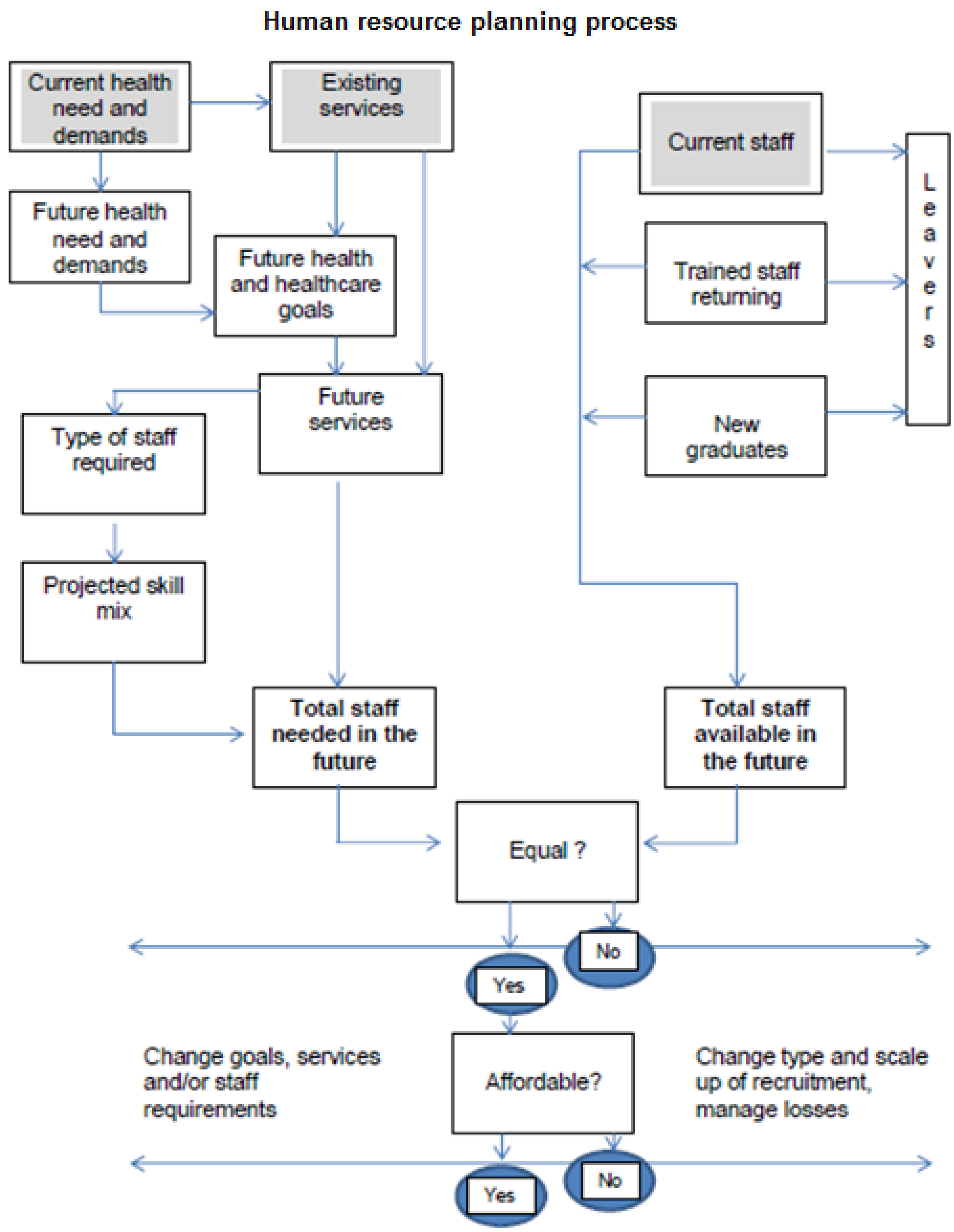
As health workforce planning is the administrative instrument to provide a rationale for decision making, it generally involves the identification and analysis of problems, the formulation of options and alternatives, and the selection of actions (Hall and Mejia, 1978; National Health Service 2012). Moreover, the importance of analysing the situation, and planning for the HRH of the ART service, is a principal resource in enabling quality, safety, accessibility and equality of care.Then to consider the workforce planning process for ART service, some queries should be raised for consideration: how many and what types of staff are necessary to deliver ART services? What is the right workforce level for the future (numbers, roles and skill mix)? These questions are the essentials of health workforce planning (Foot and Hock 2008a; Gold 2003; Hornby 2007; Hornby et al. 1980; National Health Service 2012).

Human resource planning has changed infocusingon staff numbers and functions to include the financial element which affects a limit to human resource planning. Then it is performance driven, concerned with the demand for the efficient use of resources, later (Hornby 2007). The process for planning human resources, from concept to practice, is to establish a balance between need and availability, or demand and supply (Hornby 2007); this includes demand for and availability of staff. The number of staff needed in the future can be determined by estimating the need and demand for services in the future and adding it to that already existing (Hornby 2007).

Figure 2.2 presents a conceptual view of the organisation of HRP. Future supply, or the number of staff who will be available in the future, is calculated by taking the number of current staff, adding expected numbers of new graduates and former staff returning to the workforce, and subtracting those who are expected to leave; matched against current health needs and demands under existing services, and an estimation of future needs and demands under the healthcare goals which will shape future services. The future service will consist of future staff need, detailed by types of staff and a projected mix of skills. This conceptual view is useful for HRP of ART services. For this study, the demand side was indicated by the estimated number of PLHIV who will require to access ART services, this being the number of PLHIV currently receiving ART services, plus the estimated numbers for the future. For the supply side, it is necessary to consider the types of healthcare providers who will be required to provide ART services. Then it will be possible to calculate the total numbers of staff needed in the future.

On the other hand, for the supply side, there is the need to consider the number of staff who currently provide ART services, and the projected numbers for the future which will includes those who leave and those newly graduated. These are included to calculate the number of staff available in the future.

Figure 2.2 The conceptual view of human resource planning



Source: Centre for health planning and management, Keele University (Hornby 2007).

If demand and availability are equal, planned services are affordable and can be implemented; if the imbalance of needs and availability is found, there are two options: the first, presented in Figure 2.3, is to change the goals of the service and/or the services provided or staff requirements. The other option is to change staff categories (types). Moreover, the scale of recruitment and management of staff loss must be considered in planning supply. To ensure effective supply planning, the current supply situation and labour market must be reviewed; major issues and available options identified; a supply plan developed and reviewed for feasibility; and an implementation plan developed.

The demands, needs and requirements of the health workforce

From a health services perspective, demand refers to the quantities of various types of health services that the population of a given area will seek, and have the means to purchase, at prevailing prices, and within a given time period (Hall and Mejia 1978). ‘Demand’ is used interchangeably with ‘requirement’. *Demand* is used in the context of the health workforce, whereas *requirement* refers to the amount of services and the manpower required to satisfy a given set of assumptions about how the health sector functions. *Need* represents an estimation, based on professional judgment and current medical technology, of the number of workers or services which will be required (Hall and Mejia 1978).

Estimation of demand is difficult because it is influenced by many variables; a variety of analytical techniques can be utilised for this purpose (Dreesch et al. 2005; Management Science for Health and World Health Organization 2006; O'Brien-Pallas et al. 2001; World Health Organization 2009; World Health Organization 2010d). However, many studies estimated the demand for HRP and the resulting implications.

Estimating the demand

Planners need to estimate demands in order to plan supply. There is no best method to do this; a combination of methods allows planners to find the most suitable for each set of circumstances (Dreesch et al. 2005; Hall, T and Mejia, A 1978; O'Brien-Pallas et al. 2001). Hall and et al (1978), defined four methods for the estimation of health workforce requirements; 1) health needs, 2) service targets, 3) health (or economic) demand, and 4) manpower/population ratio (Hall and Mejia 1978; Markham and Birch 1997).

Health need is the method used to identify the health services that maintain health. Health needs are determined by the judgment of healthcare providers, and are distinguished from *health wants*: the services desired by the public are not taken into consideration.

The *service target* method is based on production targets for the delivery of health services. This method may take account of a variety of inputs; health need, health demands, consumer wants, and manpower/population ratios. The healthcare system takes an active role in finding a balance between population needs and wants, and the services being offered by healthcare providers.The principle of this method fits my research design for estimating demand. ART service is a product which hasUC as the health target.

The *health (or economic) demand* method examines the kinds and numbers of services used and the cost of obtaining these services. The meta-demand is measured as health service utilisation rates, when certain costs and accessibility factors are given in certain assumptions.

The *manpower/population ratio* method uses an observed or desired manpower/population ratio to derive a manpower requirement. For example, for a manpower/population ratio of 1:1,000, 1,000 healthcare providers would be required to meet the healthcare needs of a population of one million. This method also takes into account a projection of the future requirement of the health workforce based on anticipated changes in the structure of the population (Dreesch et al. 2005; Hall and Mejia 1978; Hornby et al. 1980).

Adaptations of these methods are also employed; the *adjusted service target* method was generated for use in estimating physician requirements in Canada. Researchers investigated the current levels of services and adjusted them to reflect expert opinion. The need, service target, time and productivity method was applied to estimate the requirement to deliver health interventions responding to the MDGs (Dreesch et al. 2005).

The supply

'Supply' in the health workforce refers to the availability of resources and services at present or in the future, specifically of production, losses and current utilisation. In order to analyse supply, it is categorised into three elements: current supply, future increments and projected losses (Hall 1978). Supply includes active and inactive staff;

increments comprise new graduates, transfers from other professions and immigration from abroad; and losses comprise those from retirement, death, emigration and transfer to other occupations (Hall and Mejia 1978; Hall 1978).

Data analysis of supply in health workforce planning requires details of personal characteristics, job characteristics and qualification for the function; this can be obtained from databases or by study surveys. To collect data on loss, cohort studies are suitable for a normal attrition pattern. However, if the loss rate is unusual, there may need to be an approximation by applying the retention rate to be projected. The increment requires data concerning educational capacity, internal factors such as the quality of training institutions, and external factors such as coordination between educational institutes and licensing bodies (Hall and Mejia 1978).

Other concerns necessary for the analysis and planning of supply projections can be categorised under four different concepts by Riitta-Liisa Kolehmainen-Atken (1993). The description of methods of projecting supply and requirement are based on the work by Hall (1991), Hall and Mejia (1978), Hornby et al (1980); the four concepts are 1) *active supply* describes workers who are currently active in the healthcare sector, 2) *inactive supply*, 3) *potential supply* describes the number of potential staff who can be re-recruited and 4) *projected supply* (Riitta-Liisa Kolehmainen-Atken 1993; Hall 1991; Hall and Mejia 1978; Horby; 1980; Pan American Health Organization 1983).

Estimating supply

Estimation of supply by the application of formula is not difficult, but may be complicated by many factors, including the part-time situation of some staff, the mobilisation of staff, and the nature of changes in work practices and patterns. Three methods for estimating supply have been categorised (Riitta-Liisa Kolehmainen-Atken 1993): the cohort method, the observed-change method and the two-life time method (the simple-life-table method and working-life-table method).

The cohort method compares the number of health workers who have graduated or were licensed in a particular year with the active workers in the same profession; the loss rates are the expressed result.

The observed-changes method consists of the observation of the time series of active workers. This has precision limitations when compared to the cohort method. However, it is useful when the age-structure of a population, and the production and loss of healthcare workers, are stable at the sampled time from year to year.

The simple-life-table method uses the data of healthcare workers lost due to death; retirement and other causes of loss are not considered; as a result, supply is over-estimated.

The working-life-table method takes all causes of loss into account, resulting in greater accuracy than the simple-life-table method.

The supply-side of health workforce estimation and projection is addressed by counting the numbers of new recruits to each category of healthcare provider, projected recruitment for the future, and loss rates through retirement, emigration, and transfer to other occupations. However, there are challenges to an in-depth study: numbers are unstable due to staff mobility (Dreesch et al. 2005); and data is often duplicated or inconsistent (Jindawattana et al. 1998; Noree et al. 2005).

To achieve effective supply planning, it is necessary to review the relevant data and information and any issues involved, including the current supply situation and labour market; to identify major issues which need to be addressed and the options available to do so; develop the supply plan itself and analyse it for feasibility; and plan its implementation (Hornby 2007; Hornby et al. 1980).

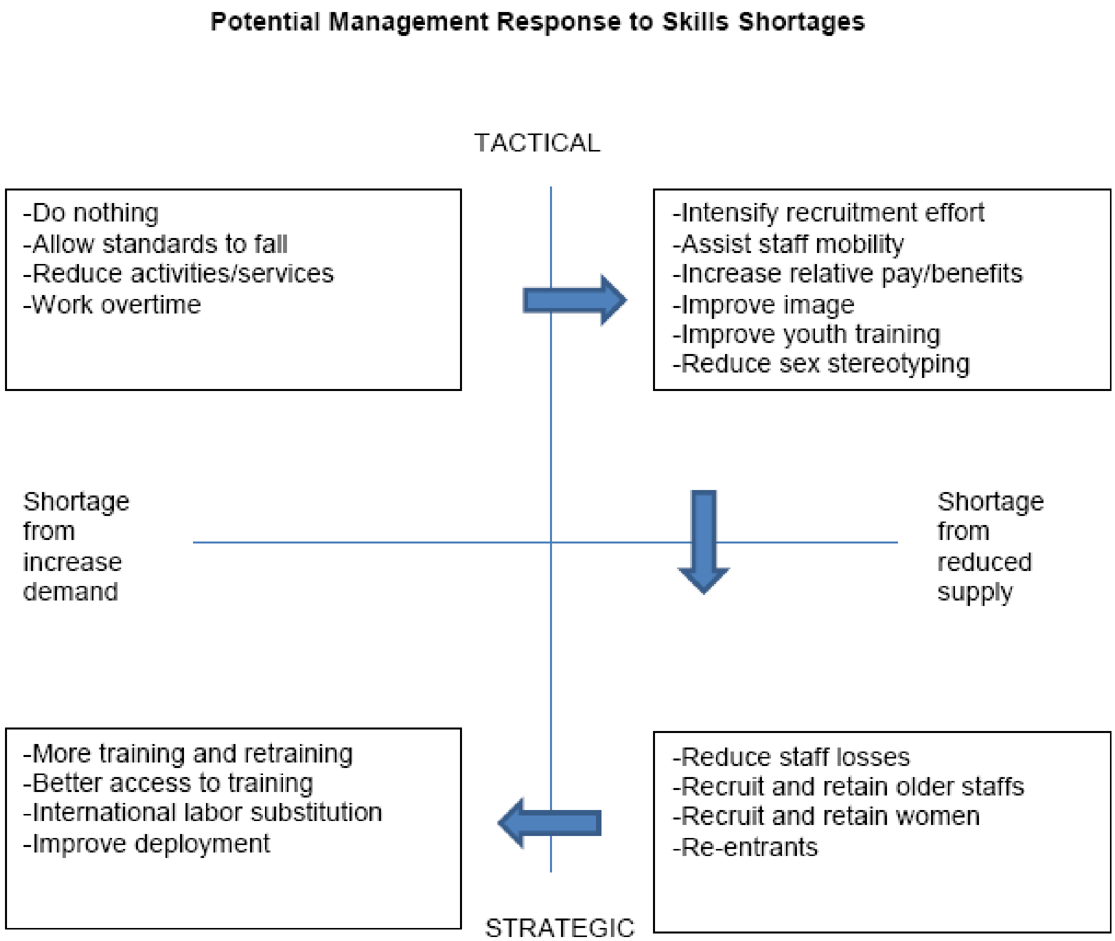
For my study, the estimations of available healthcare providers were drawn from literature reviews for four types; doctors, nurses, pharmacists and pharmacy technicians. All studies used cohort analysis mixed with simple-life method to estimate their supplies. They used current numbers of qualified healthcare providers and the annual loss rate, calculated in different scenarios to arrive at their final decision of the parameters to be used for future estimation.

There are many options to balance demand and supply; different management responses are appropriate to any imbalance. If the supply of healthcare providers is not sufficient to meet the demand for services, Hall and et al (1978), suggest the three management strategies to restore the balance: increase the supply of the health workforce, decrease the demand for services, or increase the productivity of the existing supply. They suggested that productivity can be improved by increasing the efficient use of the health workforce, the equipment, the facilities, the technology and the administrative techniques (Hall and Mejia 1978).

If the skills shortages are the result of reduced supply, strategies suggested to increase this were to intensify the recruitment effort, assist staff mobility, increase relative pay/benefits, and improve retention, by making efforts to retain older staff and reduceloss in every way possible. However, if the shortages occurred due to increased demand, the strategies suggested were to allow standards to fall or reduce the levels of service.

To respond to the increase in demand for healthcare personnel, which can be inferred from the increase in demand for ART services, more staff should be retained and trained. For other strategies, such as the recruitment of international staff, and improved deployment, could not be used for the Thai ART service, which is primarily supported by the government. Other responses to the skill shortage resulting from reduced supply could be applied to the ART service using a variety of strategies; reduce numbers of staff lost, recruit and retain older staff and women, and re-engage former staff. However, it depends on the local context of individual hospitals which strategies would suit them. Hornby (2007) suggests a potential response if there is an imbalance between demand and supply, for instance, skill shortages occurring due to increased demand and/or reduced supply: Figure 2.3.

Figure 2.3 Potential management responses to skills shortage



Source: Hornby 2007

Several studies of the recruitment and retention of health workers in rural areas revealed some practical strategies used in LMIC countries (Lehmann et al. 2008); Malawi (Martineau et al. 2006), South Africa (Blaauw et al. 2010; Martineau et al. 2006), Kenya (Blaauw et al. 2010) and Thailand (Blaauw et al. 2010). These studies identified a number of motivating factors related to staff retention: salary, career development, continuing education, work environment (hospital infrastructure), resource availability (equipment and medical supplies), working relationship with management, and personal recognition and appreciation (Martineau 2013).

The World Health Organization suggests four elements that improve the retention of healthcare workers in rural areas; education, regulatory issues, financial incentives and professional and personal support (World Health Organization 2005). The regulatory element might include the training of new types of healthcare workers, whose education would be subsidized in exchange for a compulsory period of service. Several strategies could be used as part of the educational element, including field training in rural areas; expanding the curriculum to reflect rural health issues; improving the capacity of training schools in rural areas. There is no single strategic intervention, but rather appropriate combinations adapted to suit each situation (Martineau 2013).

This section reviews the methods of the calculations for the demand and supply sides, and their balances in HRP. Keeping the balance between demand and supply is the heart of HRP. Many tactics and strategies were suggested for dealing with the situations of their shortage or over supply. For the supply side, this study estimated by selecting and applying parameters from data from the literature review, in which most data was drawn from cohort analysis and the simple-table method.

2.4 THE DEVELOPMENT OF A TOOL TO ESTIMATE THE REQUIREMENTS OF THE HEALTH WORKFORCE

Different models, tools and methods for measuring and projecting requirements and workload, as well as supply management, are applied in different contexts. For instance, trend analysis: using observed trends as assumptions for predicting the future has been applied in Canada for projecting growth in the private sector (Health Canada 2001); regression analysis modeling and analysis of numerical data, which uses the values of a dependent variable to estimate the future requirement of different categories of workforce numbers, so that the need and demands of clients and staff are met (Queensland Health 2007); meta-analysis as a technique to assess variance in coverage, classification and reporting of data (Rothstein et al. 2001); and econometric analysis, an application focusing on market factors that are assumed to influence labour participation and health service utilisations (Scheffler 2008).

Human resource projection tools were developed and applied to support the human resources planners and stakeholders in the planning process of human resources planning. Health workforce models used for projections focusing on different aspects of HRH which are not only for requirement and supply projection. The models can be used for the projection of work activities, staff development and movement (World Health Organization 2010d). To apply the health workforce models, there are variables which provide effect to the projection of future health workforce needed to be identified, for instance, health policy, public demands, burden of disease and technological change. Countries have different level of development and differences in capacities to assemble and analyse their data to assess the impact of the changes of variables. The differences in the capacity are reflected in type of approach to project the future workforce requirements with advantages and limitations (Dreesch et al 2005). The HRH planners in the countries need to determine the related variable to be used for projecting the future requirement of the health workforce.

On the other hand, to project the supply, there is a need toassess the numbers of in-flow (recruitment, new entrants, production capacity) and out-flow (loss: retirement, death, emigration, pre-retirement leaving) of human resources, type of existing staff.

Many health workforce estimation/projection tools are developed from the specifications of existing services and health workforces. There is an array of strategic human resource estimation tools (World Health Organization 2012b): the World Health Organization model (Hall and Mejia1978; World Health Organization 2010d, f), the Keele Zonal HRH model (Hornby 2007; Hornby et al. 1980, the small state/district HRH model (Dewdney and Kerse 2000), WPRO/RTC health workforce planning (Dewdney 2000; Dewdney 2001), workload indicators for staffing needs (WISN), (World Health Organization 2009; World Health Organization 2010g), the ratio method in human resource planning, Aberdeen formula, using birthrate and nurse and midwife (N/MW) staffing.

The World Health Organization’s Workforce Supply and Requirements projection model, developed by Thomas Hall (Hall 1998), was developed for a variety of purposes, including determining a workforce-to-population ratio and need-based approaches, as mentioned in details of the projection of the demand side in the previous section. It uses a freely available HRH projection model for calculating the effects of changes between linked elements. The software carries out simulations of alternative institutional development and staffing scenarios to hypothesize a variety of eventualities (World Health Organization 2010d). From its flexibility and friendly use, a

Thai study applied this model for projecting issues concerning dentists.This model is similar to that of Thomas Hall, as previously mentioned (Lexomboon 2004; Lexomboon and Punyashingh 2000).

An alternative model is the WHO Western Pacific Regional Office/ Regional Training Centre (WPRO/RTC) health workforce-planning model. It can be followed step by step as part of the process of producing a workforce plan. It was developed by Dewdney (Dewdney 2000; Dewdney and Kerse 2000; Dewdney 2001) and has been widely used in Africa, Asia and the Caribbean (Dewdney and Kerse 2000). It is considered for use when the population size and staff categories for the estimation and projection are small (World Health Organization 2010d).

Another model which is widely used for specific studies to support decision making, including workload indicators for staffing needs is the WISN methodology (World Health Organization 2009; World Health Organization 2010g). This model is a tool developed by the WHO in order to set activity/time standards for health personnel and then translate this information into a workload projection (World Health Organization 1998; World Health Organization 2009). This model provides good points; any imbalance between staffing and workload reflects the fact that staffing is based on facility capacity, for example, the number of in-patient beds, and not on service utilization. Several countries have used this method to improve their HRH plan: Bangladesh (Hossain and Alam 1999), Turkey (Namaganda 2004) and Uganda (Ozcan and Hornby 1999). For my study, I applied a task analysis using a modification of the WISN method, the tasks in ART services being similar to those in institutes and hospitals for which the WISN method was previously used. The other tool I used to estimate human resource requirementshas been refined since 2002 by Kurowski and

Mills (2006): the QTP model. This tool is used for estimating the requirement for scaling up priority health interventions in low and middle income countries of sub-Saharan Africa, using a methodology based on three variables: service quantity, tasks and productivity (QTP), (Kurowski and Mills 2006). It is rooted in the concept of functional job analysis. The service quantity (Q) refers to the frequency of specific interventions. However, in reality, most countries did not report service quantities, but coverage, which is the number of services provided relative to the number of services needed (service quantity is based on estimates for the number of services needed and information on service coverage). Service coverage targets are then formulated for a range of priority interventions. The study of Kurowski and Mills set 42 priority interventions and 70 treatment lines (Kurowski and Mills 2006) which a certain task (T) and skills are required to accomplish. The definition and specification of tasks was at the core of the model. Productivity (P) is classified as staff productivity (spending hours (%) on productivity) and service productivity (proportion of productive staff time spent on priority interventions). Kurowski and Mills (2007) applied the QTP model to project HRH requirements and availability based on a 2001/2002 Tanzanian HRH census (Ministry of Health Tanzania 2004).

In comparison, the WHO inter-cluster collaborative working group, using a similar approach, estimated the HRH required to achieve MDGs (Dreesch et al 2005). The differences between these two models were compared; the QTP explicitly considers staff and service productivity, which are critical elements in redressing HRH shortages. The QTP allows individuals to seek and receive treatment and care at all service delivery levels, not only those addressed by the package of priority interventions.

On the other hand, the WHO inter-cluster collaborative working group proposed incorporating managerial functions at many levels of service delivery, but the QTP model cannot conceptualise managerial functions, because the principle of job analysis of the QTP model does not support the well-established standards and requires discretion in the execution.

Another differrence between the QTP model and the approach proposed by the WHO cluster collaborative working group is the procedure of data collection. Researchers using the QTP model generated time weight through interviews with healthcare providers (rather than expert opinion or observation). The selection priority interventions follow recommendations of the Commission on Macroeconomics and Health adjusted to the specific policy of the country (rather than developed in a national process), (Kurowski and Mills 2007).

The QTP model produces an estimation of HRH requirement, integrating staff and service productivity. It is a task-specific requirement. I believe that the QTP model output is robust enough to project HRH requirement, because the study compared information on staff density and service coverage with international information.

However, the weakness and limitations for strategic HRH planning were indicated in applying the QTP model. This model is complex and the requirement of data is extensive. This model failed in its application into the model of health system management function and facility level (as mentioned in the above paragraph, because the QTP model does not support the well-established standards, and requires the discretion in the execution). The feature presented in the case study in Tanzania which was for HRH requirements for service provision at the lower level of care imposedrestrictions in more generic uses of the approach, as proposed by the WHO inter-cluster working group (Dreesch 2005).

Morever, the QTP model is not easy to apply for the estimation of the health outcome target of the MDGs, because it is based on need and coverage targets (Kurowski and Mills 2007). Lastly, this model also ignores the variations of geographic, ineffective recruitment procedures.

To select a tool to estimate health workforce requirements in this study, some tools were partly applied. Firstly, my study applied with a part of the workload indicators of staffing need (WISN) tool (World Health Organization 2009; World Health Organization 2010g) by applying the process of task analysis of ART service, and using a workload rationale to calculate staff need (World Health Organization 2008a) which underpins some of the different approaches of HRP. This approach has many desirable features and based on demand to determine requirements and gaps(Dreesch et al. 2005; Mcquide et al. 2008; World Health Organization 2010d).

Another study which seemed to have aspects in common with my area of interest was the study of HRH providing ART services in Zambia and Mozambique (Smith 2005). In 2005, Smith estimates the human resource requirement for achieving the goal of the U.S. President's Emergency Plan for AIDS Relief (PEPFAR); this organization is the U.S. Government initiative to help save the lives of two million PLHIV in 14 countries by treating them with antiretroviral drugs (Smith 2005). They applied task or activity analysis for HIV/AIDS treatment and used the basic calculation of the study[13] multiplied

[13] Smith (2005) used basic calculation with equation simulation for two scenarios; providing ART services with and without the participation of community workers; the formula of basic calculation used is shown as follows:

the number of patients receiving care by the time taken per patient for service delivery, and divided this by the amount of time that each health worker could spend seeing patients in a year. Smith used parameters of the time available for each healthcare worker as 1,000 hours per year, 4 days per week and 5 hours per day. The result showed that community health workers provided ART services with a good quality of care and reduced the workload of healthcare providers.

The other studies (Kuroski and et al 2006, 2007) estimated the time required to provide activities/tasks of the interventions to the communicable disease, maternal and perinatal conditions and nutritional deficiency by 2015 which included the time required to provide ART services. They estimated HRH requirement as FTE in the final step of the model. The three principle variables of service quantity, tasks and productivity are combined. The model calculated the HRH requirements for each intervention in minutes by multiplying service quantity estimated with task matrices. Then they added all results together and converted to HRH requirements by correcting the results for combined productivity. This model calculated the numbers based on net working days per year and working hour per day which is similar to the method of my study design. Eventhough this model is far more complex and different in the model which based on three variables comparing with my study; however, the basic principle of task analysis and calculation are the same.

The formula to calculate the FTE was used for the linear relationship, which was reliable for the purposes of calculation when parameters were predictable. There were more studies (Van Damme et al. 2007; Barnigausen et al. 2007) applying the same

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Human resource requirement = (number of patient x annual patient time require for services)/ provider time available to spend with patient per year.

calculation which is similar to the study that I reviewed in above paragraphs (to come up with the FTE of healthcare providers in the year in question).

I further reviewed two studies to compare the methods for estimating workforce requirement in FTE; from Malawi (Muula et al 2007) and Cambodia (Van Damme et al. 2007). Malawian study (Muula et al 2007) applied a basic calculation which was used in the Cambodian study (Van Damme et al. 2007) to estimate and simulate the FTE of human resources with differences in scenario and also used the data of Cambodian study[14] to estimate the need of clinicianat 95,674 (at the end of March). The Cambodian study highlighted two main factors: variation of the time taken by doctors to provide ART services, and the survival rate of PLHIV, by projecting the FTE from 2004 to 2013, but Malawian study estimated only the requirement of doctors for estimated number of total PLHIV; 170,000 patients.

Another study of interest of my study aimed to estimate the needs, capacities and gaps in human resources to treat HIV/AIDS in three regions: sub-Saharan Africa, non-sub-Saharan Africa and South African countries. The workforce requirement to provide ART services to 5 million PLHIV was projected, using a simple discrete time model, and a Markov deterministic system with a health worker pool diminished through emigration and death, and a base of 1,000 PLHIV, by projection from 2006 to 2017 (Barnigausen et al. 2007). They used an assumption of 15% of total cases of PLHIV needing ART. They also simulated the model with variations in survival probabilities.

[14] Van Damme et al estimated in Cambodia that 2.06 FTEwould be required atthe inception of a treatment program for 522 patients. In subsequent years,this would change to1.97 FTE for 911 patients. A reduced patient-clinician consultation was due to the doctors gain experience and patients has been stabilised on treatment.

The result showed that increasing the flow of HRH would be more effective in increasing numbers than attempting to decrease HRH emigration rates.

The Barnigausen et al (2007) study initiated me the idea of simulating the time required for HRH to deliver ART services part of my study. Two other studies using the Markov model simulate using a different CD4 level and two different base line drug regimens to compare the cost effectiveness (McPake et al. 2013; Maleewong et al. 2008) of these drugs regimens, and cost utility (Cleary et al. 2006). The possibility of estimating the cost of antiretroviral drugs is one of the advantages of the Markov model.

This section provided the variety of tools to be used and the development for my study. The tools in this study was developed and applied from mixed types of tools from literature reviews. WISN, QTP, applied Morkov analysis from African countries, applied Markov analysis from economics study in Thailand. However, majority of the tools used in my study are suited to Markov anslysis because the Markov analysis could be used for projecting time required to provide ART services for PLHIV that could change their characteristic treatment outcomes during the time when they were receiving ART service, with random process undergo of transition from one state to other state.

2.5 PLANNING OF HEALTH WORKFORCE AND STRATEGIES RESPONDING TO AN INCREASING DEMAND OF HEALTH WORKFORCE TO DELIVER ART SERVICES

HRP requires the balance of demand and supply of health workforce. The achievement of the UC of healthcare services is a task which requires more than medical skill and application. It is implicit that the health sector of each country will need to expand the capacity of healthcare services, which will in turn require an expansion of health workforce to contribute. Moreover, maintenance and sustain the ART service for either new cases or life long PLHIV have been adding up the requirements of the service (Bratton 2003b; World Health Organization 2006b). The increase of ART service from UC policy and PLHIV have been living longer after they received ART indicated the increase of demands of health workforce. On the othe hand, the supply which is the healthcare providers who deliver ART service also required to be in balance of the demands of ART service. HRP is concerned with types of healthcare worker, skills, work environment organisation, capacity, performance, distribution and efficiency. An obvious element of health workforce planning is therefore to improve the quality of decisions and facilitate the balance of demand and supply of the health workforce. From the increasing of demand of the service, it is clearly that there is the need to consider in the balance of the demand and supply side of HRP.

Many countries have implemented innovative strategies to expand the capacity of health systems to address HIV/AIDS and other challenges. These include increasing the use of non-medical partners to manage health care facilities. However, in some countries, in order to make the required impact, there is a need for innovative or adaptive ART delivery models to maximise workforce utilisation.The most important thing is to recognise that no single solution to copechallenges. Each country has to develop their own multi-pronged strategies and techniques for a solution which suits their health-system context and local circumstances (Dovlo 2004; Hongoro and McPake 2004; Van Damme and Kegels 2006; Van Damme et al. 2007).

2.5.1 Incentivising strategies for ART services

Some countries have devised and applied incentivising strategies (World Health Organization 2004a; World Health Organization 2004b); this option does not increase the workforce directly, but encourages staff retention and more productivity from staffs; both financial and non-financial incentives have been applied (World Health Organization 2004a).

The non-monetary incentive was in the form of training given to local staff, giving them the opportunity to join central teams for meetings, knowledge updates, sharing information and experience, writing journal articles for publishing as part of a team or even participating in international conferences. These kinds of incentives were applied in many countries, especially UN-members whose governments had committed to the provision of universal access to ART services for all PLHIV eligible for treatment. In Thailand, two cadres of healthcare personnel, doctors, nurses and pharmacists working for the ART service have received a topping-up salary paid by the royal Thai government since 2006 (The Royal Thai Government 2006).

Some governments did not use salary increase as an incentive. Staff in these countries were public employees with official salaries; examples are Botswana (Ministry of Health 2010; Stover et al. 2008; World Health Organization 2004a) and South Africa

(De Waal and Whiteside 2003; Kober and Van Damme 2004; Schneider et al. 2006b; Tobi et al. 2008). However, some countries, including Malawi, Uganda, Kenya and Cambodia, provided financial payments in addition to official salaries; this was markedly the case in countries where ART services were provided in the pilot phase by Non-government organizations (NGOs) with external funding. Staffs who were paid by these external funding bodies received higher rates than the salary offered by the government. This caused conflicts in Cambodia and Kenya (Ministry of Public Health and World Bank 2004).

Effective management skill needs incentives built into the healthcare system (Atkinson 1984). The strategy of providing incentives can motivate staff, as indicated in many countries, especially during the pilot phase of the scaling up of ART. However, there is a concern that the incentives will be a challenge to maintain in the future, especially when ART becomes a routine service. In Thailand, ART serviceshave been integrated into the universal coverage scheme as a routine service. However, the government has provided the incentives to doctors, nurses and pharmacists who have been working for ART service.

2.5.2 The task-shifting strategy for ART services

Focusing on the recommendations of the adaptive model of ART services, the WHO recommends two strategies to solve the problem of staff shortages and role in HIV clinics (World Health Organization 2010d): one is an increase in the number of cadres providing the services; the other is the reorgnisation of clinical roles by shifting tasks to different healthcare cadres, in or out of HIV clinics, and adopting effective delivery models that might reduce the need for doctors or nurses, or other higher cadres of healthcare provider. Nurses may prescribe drugs instead of doctors, or may provide counselling, instead of counsellors. Lay healthcare workers may dispense drugs instead of pharmacists (Wagner et al. 2007; World Health Organization 2004a). New cadres may be introduced to the service to take over some elements of care. All the above practices have been termed “Task Shifting”, and aim to relieve pressure on workers and strengthen the workforce part of the health system, while maintaining quality of care and increasing access to care (World Health Organization 2008c). The World Health Orgnization has described task shifting as the rational redistribution of tasks among health workforce teams (World Health Organization 2008c), making the most effective use of available human resources.

The need is to shift tasks from doctors to nurses, and from nurses to community health workers, in clinical settings, and to create arrangements between local clinics and institutions. This innovative response to HR problems has already been introduced; for example, the use of task shifting to delegate tasks previously performed by physicians to staff with lower-level qualifications, which may include lay and community workers (World Health Organization 2008c). Task-shifting offers high-quality, cost-effective care to more people than a physician-centred model is able to do, reflecting the competency of adaptive healthcare services. The main challenges to its implementation include the need for adequate and sustainable training, support and pay for staff in their new roles, integrating new members into healthcare teams, and compliance with regulations (McPake and Mensah 2008; World Health Organization 2008c).

The task shifting strategy reflects an increase in the accessibility of the service, the competency of the heath workforce, and the efficiency of ART services, as well as an increase in the availability of the supply side. In resource-poor countries, including those in sub-Saharan Africa, non-physicians have been trained to fill various traditionally physician roles across the continent. For instance, Uganda and Zambia shift tasks to and from community healthcare workers to lay workers or clinical officers, in order to deliver ART services (Callaghan et al. 2010; McPake and Mensah 2008; Mullan and Freywot 2007; World Health Organization 2008c).

South Africa does not allow this by law and regulation; however, lay workers can help healthcare providers in ART clinics to provide education to patients under the practical supervision of the official ART delivery team (Wagner et al. 2007; World Health Organization 2004a). Task shifting increases ART-programme efficiency by addressing bottlenecks in services (Chung et al. 2008), for example by reducingwaiting times and loss to follow up in Rwanda, Nigeria, Malawi and Kenya (Kosgei et al. 2008; McQuire et al. 2008; Torpey et al. 2008; Udegboka and Moses 2009), increasing access to healthcare in Botswana, Zambia and South Africa (Gioris et al. 2009), and improving quality of care in South Africa (Wood et al. 2009).

Task shifting was reported to have resulted in higher job satisfaction, lower workloads and lower usage of sick leave in South Africa (Arem et al. 2009; Tobi et al. 2008). Task shifting involved PLHIV in their own care, or the care of others, and influenced the social dynamics within a clinic in Cameroon (Chang et al. 2008; Kober and Van Damme 2006; Tantchou and Grue'nais 2009).

Task-shifting is an effective strategy for addressing staff shortages in HIV treatment and care. A systematic review for ART care in Africa (Callaghan et al. 2010) found that it offered high-quality cost-effective care to more PLHIV than a doctor–based ART delivery service. Sub-Saharan African countries have the highest numbers of PLHIV in the world, and the most HRH crises. The literature review showed that 36 out of 57 countries confronting healthcare worker shortages were in Africa (World Health Organization 2008c). These countries have to consider effective strategies to alleviate this shortage. Task-shifting is an effective answer for them to allow rapid streamlining of ART, while maintaining a high quality of care, and scaled-up and expanded access to care. The practical meaning of task-shifting is to shift the tasks of ART to different cadres of health care workers by training them to perform specific tasks within their contexts of care, while maintaining quality standards and increasing access to services (McPake and Mensah 2008; Tootla et al. 2007; World Health Organization 2008c).

In 2008, the global community including the WHO, UNAIDS and PEPFAR gathered to expand and developguidelines for the implementation of task-shifting, to address staff shortages as a priority. However, sub-Saharan African countries, having practised task-shifting, identified the need for care in its implementation: it should not be used in conjunction with low pay and poor working conditions, which brings about a worse situation than that which existed before implementation (Ojikutu 2007; Philip et al. 2009; Philips et al. 2008; Schneider et al. 2006a; Zachariah et al. 2009; Zelnick and O'Donnell 2008).

As previously mentioned, the application of task shifting is aimed at transferring tasks from a doctor-based ART delivery model to a nurse- and community-based model. In South Africa, a nurse-driven model is being used to decentralise ART provision and expedite treatment scale-up. A randomized, controlled trial, which assessed the effectiveness of task-shifting for ART delivery in urban clinics in Johannesburg and Cape Town, found that nurse-managed ART was not inferior to doctor-managed ART (Stover et al. 2008). Similarly, in Rwanda, nurses accurately determined eligibility for ART for more than 99% of the people examined (Chung et al. 2008; Ritzenthaler 2005;

Shumbusho et al. 2008). In Mozambique, people seen by mid-level health workers (with 2.5 years of training) were almost 30% more likely to have CD4 counts performed six months after antiretroviral therapy was initiated than those seen by doctors, and were 44% less likely to be lost to follow-up. However, there were no significant differences in mortality or adherence rates when CD4 counts were done after 12 months, (Jahn2008).

A study from Malawi (Shulman et al. 2009) found that the training of lay workers as pharmacy assistants reduced prescribing errors by 25%. In the Democratic Republic of Congo, a study examined concordance between the decisions of doctors and nurses to initiate ART services and found 95% agreement on initiating therapy (Anand 2009).

In Zambia (Morris et al. 2009) and Mozambique (Gimbel-Sherr et al. 2008), the projection for the 10 year scaling-up of ART services from 2008 would need two to four times as many doctors as were currently practising, respectively. However, the study to Mozambique projected another scenario which used community workers to deliver some ART services; this estimated that the HRH requirement of doctors would decrease by about 50 FTE.

Studies in sub-Saharan African countries show that the accessibility of the ART programme is increasing (Gioris et al. 2009; Koenig et al. 2004). In Botswana, drug prescription was carried out by trained nurses, increasing the number of PLHIV accessing ART services at rural clinics by 20,000 (Hulea et al. 2008).

The task shifting approach in Zambia consisted of providing intensive training to health providers and community-based workers in the tasks that would be shifted in the ART model; this resulted in success in expanding treatment and accessibility, while maintaining high standards in quality of care (Morris et al. 2009). Similarly, studies in

South Africa, Mozambique, Kenya and Swaziland report an improvement in accessibility to the ART programme within as short a time as two years (Assan et al. 2008; Bedelu et al. 2007; Chiambe et al. 2009; Mareverna et al. 2008).

Most studies reviewed indicate the effectiveness of task shifting. Many studies report a quantifiable time saving from the application of this approach. When tasks previously carried out by professional staff are delegated to less qualified team members, or outside the team to community workers, highly-qualified staff have more time to deal with complicated cases; so time saving is the main outcome of this approach to ART, reducing the congestion of patients waiting for treatment, and the numbers of patients lost to follow-up (Chung et al. 2008; Schneider et al. 2008; Stilwell et al. 2008).

Quality of care delivered by nurses was no different to that of doctors, in a study conducted in South Africa (Wood et al. 2009). The same results were found in studies in Rwanda, Mozambique, Malawi and Cameroon (Gimbel-Sherr et al. 2008; Shulman et al. 2009; Shumbusho et al. 2008).

There were limitations in the analysis of the cost effectiveness of task-shifting: a formal study has not yet been conducted. However the literature review showed positive evidence of effectiveness and economic advantage (Dovlo 2004). Community healthcare workers and non-professional healthcare workers are able to deliver ART services equal or better in quality than professional-based care models. Several studies on task shifting of ART services from doctors to nurses showed good clinical outcomes with fewer errors, such as those conducted in Zambia and Uganda (Bolton-Moore et al. 2007; Chang et al. 2009; Callaghan et al 2010; Lung et al 2011).

A study of the outcome of the decentralised programme in rural South Africa reported a good clinical outcome for patients receiving ART services from non-physician providers

(Bedelu et al. 2007). Similarly in Lesotho, and Rwanda, a high quality outcome in terms of mortality and retention in treatment was shown (Cohen et al. 2009; Tootla et al. 2007). A home-based care study in South Africa, Uganda and Malawi also supported a positive outcome for task shifting, showing similar clinical outcomes when lay workers delivered the services (Jaffar et al. 2004; Weidle et al. 2006). The task shifting strategy resulted in a higher level of job satisfaction, and a lower workload and level of sick leave among staff. Evidence of this was found in many study reports in Cameroon, Uganda and South Africa. The relationships among professional staff and community workers were also found to be better (Arem et al. 2009; Tantchou and Grue'nais 2009; Tobi et al. 2008).

2.5.3 Staff-mix and skill-mix implications for ART services

Exploration of innovative ways to deploy the workforce, carried out among worldwide healthcare organizations, has focused on staff-mix: defined as the ability of health systems to provide safe, high-quality, effective and patient-centred services depends on sufficient, well-motivated, and appropriately skilled personnel operating within service delivery models which optimise the performance of a specific mix of different types of personnel (Dubois and Singh 2009; Dussault and Dubois 2003). Another definition of staff-mix is managing human resources in health care with groups of workers with different professional backgrounds, skills, grades, qualifications, expertise and experience in order to achieve optimal patient care (Duffield et al. 2005). However, the same staff-mix cannot be applied in all contexts, but must be modified to fit the organisation, and to allow the health system to work effectively (Dubois and Singh 2009; Dussault and Dubois 2003).

HRH requires the management of workers with different professional experience, skills and qualifications. This management is the area of the healthcare system which deals with the concepts of staff-mix and skill-mix across different professions and their organisations. The conceptualisation of the staff-mix can be divided into four concepts.

Firstly, different healthcare professionals work together to provide different aspects of care as a ‘multi-disciplinary team’, a process called ‘mixing disciplines’. A basic multidisciplinary healthcare team comprises a doctor, a nurse and sometimes other professionals; for example, a primary care team would comprise a doctor, nurse, pharmacist, mental-health worker and primary care worker. However, the literature review found that there was no consistency in the effectiveness of a multi-disciplinary team compared to the care provided by a single group of professionals, although the importance of staff in a mixed-disciplinary team using their particular skills to their full potential was highlighted (Dubois and Singh 2009; Wagner 2000). A second focus of several studies was the number of health workers in a team, which had an effect on the quality of care and the outcome of services (Dubois and Singh 2009).

Thirdly, the proportion of more highly qualified staff in the HRH pool was important. Many studies found that having more highly qualified staff contributed to a better clinical outcome (Aiken et al. 2003; Blegen et al. 2001).

The last conceptualisation was balancing junior and senior staff members, measuring seniority by the number of years worked for a particular organisation. The longer the experience, the better the clinical outcome (Sasichey-Akkadechanunt et al 2012).

The WHO reported that the right mix of health personnel was the major challenge for a health system (World Health Organization 2000). In practice, an organisation providing healthcare can decide the right mix of staff. However, the definition of skill-mix may refer to the combination of activities which comprises each role, instead of the combination of different job titles (Buchan and Dal Poz 2002; Buchan and Calman 2005). Other definitions of skill-mix are the mix of posts in an establishment; the mix of employees in a post; the combination of skills available at a specific time; or the combinations of activities that comprise each role, rather than the combination of different job titles (Buchan et al 2001).

Within the concept of skill–mix is another term, used for both multi-skilled workers who can switch from one role to another within a wide range of health services, and the shifting of tasks to health workers who will be able to meet multiple patient needs: role enlargement. This is particularly effective when caring for patients with chronic conditions. Staff are not replaced with when further skills are required, but have their skills and roles expanded to correspond to the needs of the ART service (Pruitt and Eppinbg-Jordan 2005).

The review of Buchan (2006) shows that skill mix is the driver of skill shortage (a response to shortages of staff in particular occupations or professions), cost containment (improving management of organization costs, specifically labour costs), quality improvement (improving quality of care), new medical interventions and new health sector programmes or initiatives. All drivers provide possible interventions to be applied to achieve universal access to the ART programme, with consequent impacts on HRH. New medical interventions were the driver which corresponded to the changein the ART guideline, which specified a CD4 count of 350 cell/mm^3 as the new enrolment criterion in 2013. There is a need for possible interventions of staff re-training, new skills, a different skill mix or new types of health worker.

Another driver is the new health sector policy of decentralisation, in which health centres have been transformed into sub-district hospitals. To maximise the benefits of this programme appropriately, skilled workers had to be in place, necessitating an appropriate mix of staff skills, skill enhancement for existing staff, and the introduction of new health workers. In Thailand, confronted with major changes related to almost all the main drivers: either the change of new medical interventions, specifically the new enrolment guideline for PLHIV with a CD4 level from 350 cell/mm^3, or the major change represented by the decentralisation of the Thai healthcare system.

2.5.4 The community approach to ART services

The approaches used for the delivery of ART services vary in levels of care from national strategic approaches to community based approaches. Several different sectors are also involved: government organisations, private sector initiatives such as company schemes, private healthcare facilities and physicians, NGOs, and even family-member care schemes. Community is defined here as a unit or group of people which exists closest to the family, and which fundamentally supports families and individuals from birth till death (World Health Organization 2004a). Before close exploration and analysis of the community-based approach to HIV/AIDS services, it is necessary to touch upon the fundamentals of primary health care, which shows the role of community healthcare workers in the context of the health system. In 1978, health experts and policy makers from the 134 member countries of the WHO convened in the former Soviet Union for a conference on international primary healthcare. At the time, it was estimated that twobillion people had no access to adequate health care, generally thought to be because of the vast inequalities between rich and poor countries, and between rich and poor populations within countries (International Conference on Primary Healthcare 1978). On Sept 12, the Alma-Ata Declaration was signed, with the ambitious target of achieving “Health for All by 2000”. Community health workers have been recognised as key figures in promoting this goal. The Alma-Ata Declaration was the first evidence of the importance of the community approach, which has continued to make a positive impact on the health system ever since.

Since the signing of the Declaration, HIV/AIDS has spread across the globe, overwhelming the capacity of healthcare providers and increasing the constraints of the existing, already limited, human resources of health systems. Community health workers have been providing healthcare services for PLHIV at the community level. HIV/AIDS is exerting enormous pressure on communities, especially the care and support systems. The services of care and support given to PLHIV are mainly to support physical health. However, the burden of psychosocial support is largely borne by the community. The typical community worker is not a professional healthcare provider, but they fulfill much of that role, delivering practical HIV/AIDS services in the community. Some are PLHIV themselves, or have a family member who is (Farmer et al. 2001; Walt 1990; World Health Organization 2004a; 2004b). Community workers or informal healthcare workers are part of the human resource pool employed in HIV/AIDS prevention and care services. They provide many health services as well promoting the key principles of primary health care, including equity, collaboration and community involvement (Walt 1990).

In most countries in sub-Saharan Africa (Botswana, Nigeria, Rwanda, Kenya, Ghana, Malawi, Tanzania, Uganda and Senegal), governments have taken the lead in scaling-up ART, starting initially with pilot studies in some hospital clinics, then in provincial and regional hospitals and finally nationwide (Arem et al. 2009; Attawell and Mundy 2003; Chang et al. 2008; Chang et al. 2009; Ritzenthaler 2005; Wagner et al. 2007; World Health Organization 2004a; World Health Organization 2004b).

This approach is similar to the approach that many countries in South-East Asia apply: Thailand[15], and other countries including the Lao PDR, Cambodia, Vietnam, Myanmar, Malaysia[15] and Indonesia. The governments of these countries have taken the lead in providing ART services in a vertically-organised system, in collaboration with multiple stakeholders, including NGOs such as Médicins sans Frontières (MSF), multilateral organisations such as WHO, UNAIDS and UNICEF, or global Public Private Partnerships such as the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM), (World Health Organization 2007b).

By contrast, some countries originated ART services at the community level and in a third set of countries, international, national and local and national NGOs were at the forefront of providing ART. For example in South Africa[15], MSF used a nurse-based delivery model before scaling-up across the country. In Haiti, the ART programme was developed from clinics at a community level, by NGOs and international collaboration through a community-health-workers-based model. Haiti (the poorest country in the western hemisphere) has mobile volunteers delivering ART at the community level; this has demonstrated that it is possible to deliver ART programmes in poor, rural communities by relying on an already-existing infrastructure, in this case for the control of tuberculosis (Farmer et al. 2001).

[15] South Africa, Brazil, Mexico, Thailand and Malaysia became new industrialised countries in 2011

Similarly, Brazil, Argentina, Mexico, Ukraine, China, Lesotho, Mozambique, and Zambia adopted a doctor-based delivery model. However, these countries use trained nurses and community health workers to administer complex regimens and monitor side effects, in order to rationalise staff requirements (Hanefeld and Masheke 2009; 2010; Kober and Van Damme 2006; Pan American Health Organization 2003; Steyn et al. 2009b; Van Damme and Kegels 2006; Van Rensburg et al. 2008; Wagner et al. 2007; World Health Organization 2004a).

2.6 THE THAI ART SERVICE AND ITS IMPLICATIONS FOR THE HEALTH WORKFORCE

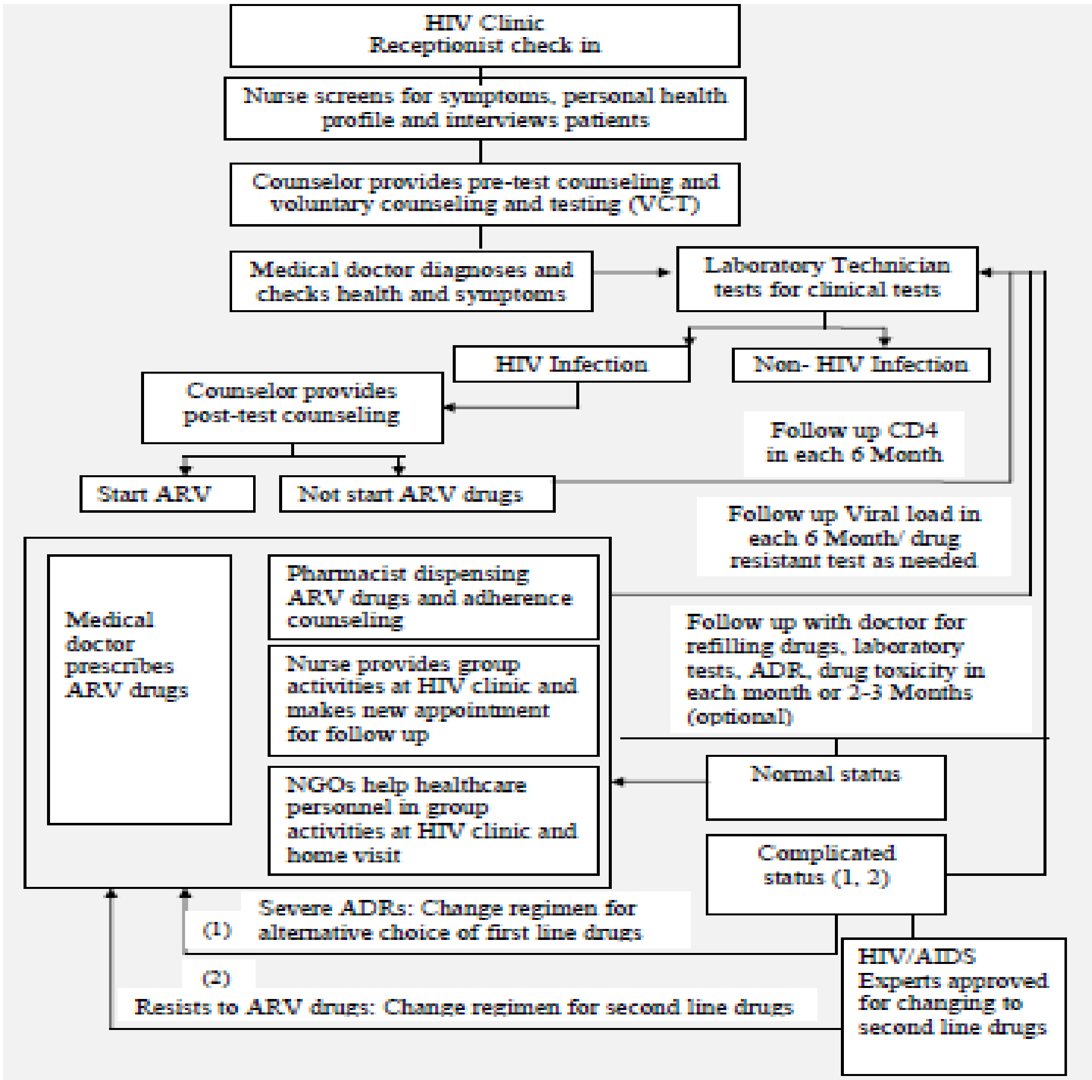
The Thai national ART practical guidelines recommend a multi-disciplinary team of five cadres; physicians, nurses, pharmacists, laboratory technicians and counsellors, to provide ART services. Healthcare providershave delivered services in the health system for the whole health service, which includes around 30,000 medical doctors, 120,000 nurses, 8,000 dentists and 10,000 pharmacists. For the other healthcare providers, such as community healthcare workers, the national guidelines recommended their participation in hospital ART clinics if possible. The numbers of this group of healthcare providers is not in the national database and could not be accessed (Ministry of Public Health 2010b). ART services are generally delivered in a clinic separate from other units (Figure 2.4).

The services start with a counsellor; voluntary counselling, testing and pre-test counselling, to prepare people for a check of their HIV/AIDS status. If a positive result is indicated, and if the person has a CD4 level of 200 cell/mm^3 (in the 2010 guideline), (Ministry of Public Health 2010b), or less, a doctor provides counselling, prescribes

ART with a first line drug regimen, and makes an appointment for following up clinical status and drug compliance within two weeks. Nurses pre-check health status and pharmacists dispense drugs and provide counselling. Normally, all ART clients will be given a monthly appointment to follow-up compliance. After approximately six months, frequency of follow-up is reduced to every two or three months.

At follow-up visits, the doctor has the authority to change the drug regimen for other choices of first-line regimen; if drug resistance is suspected, or adverse drug reactions are encountered, the doctor considers requesting drug resistance testing, or changing the regimen, potentially to a second line or other drug regimen.

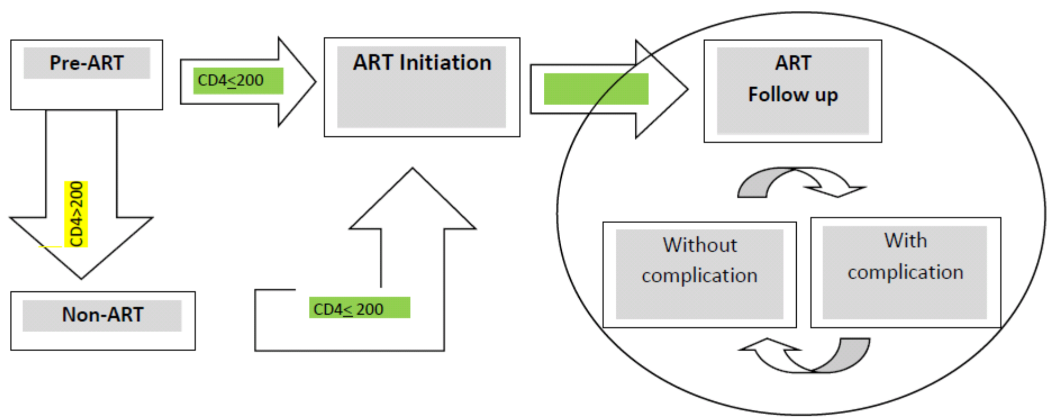
Figure 2.4 The ART delivery model and task allocations for the ART team among the five main cadres of healthcare providers at an HIV clinic



Source: The model created by the researcher of this study with information from the study of Jirawattanapisal (2010)

PLHIV who need ART will go through several treatment phases: pre-ART; starting ART (initiation); treatment continuation with / without complication[16] (Figure 2.5). Treatment with complications requires more processes, takes more time for service delivery, and needs the expertise of a physician to determine health status and treatment options.

Figure 2.5 Phases of ART enrolment and the two health states of the following-up phase (Thailand 2012)



The evidence of studies conducted in 2006 found that the two policies of universal coverage for general health care and universal access to ART services put increased demands on the health workforce, particularly among public healthcare providers (Pachanee and Wibulpolprasert 2006). Ensuring equity in healthcare access in this scenario of competing demands from these dual-track policies was a challenge to policy makers and analysts. The same study identified the shortage of healthcare

[16] Complications of ART include adverse drug reactions and resistance to drugs, necessitating more time for diagnosis and treatment

workers in rural areas, as well as their skewed distribution. Other studies show the same evidence, supporting the belief that the Thai healthcare system needs to plan and implement policy strategies to address these HRH problems (Noree et al. 2005).

Existing problems of the health workforce in Thailand, worsened by the demands of the ART programme, are inequitable distribution, shortages, difficulties in the provider-patient relationship, and low morale and productivity (Noree et al. 2005; Payanantana et al. 1998; Srisuphan et al. 1998; Suwannakij et al. 1998). The remaining challenge that needs immediate attention is the retention and motivation of health workers in the rural health-infrastructure.

The problem of highturnover, especially among medical doctors and nurses, necessitates continuous training and retraining in HIV/AIDS care, which has relevance to investment and may mean the disruption of services, as well as task shifting to lower-level cadres. In spite of the high financial incentives, there are still wide gaps in HRH distribution (Noree et al. 2005; Thammarangsri 2004a; 2005a).

The role of community health workers in rural areas is to work with the medical professionals as part of the ART team. They help pre-pack the anti-retroviral drugs, provide group counselling alongside professional counsellors, and distribute information about HIV/AIDS and treatment in the local language, helping PLHIV understand without the potentially difficult medical terminology used by professional health workers. As they are mostly PLHIV themselves, many of the patients are their friends, (Chasombat et al. 2006; Chasombat et al. 2009; Panupak 2004).

Thailand's country report of the United Nations General Assembly Special Session (UNGASS) in 2009 reported over 440 NGO groups working as community health workers, supporting healthcare professionals in the delivery of ART services in urban and rural areas. They work closely as partners in the healthcare teams in hospitals (Ministry of Public Health 2010c). The Thai Network of PLHIV, together with the AIDS Access Foundation and Médecins Sans Frontières (Belgium), has supported the increased participation of PLHIV in their own care and treatment program development and services, through "Comprehensive Continuum of Care Centres", of which there are 367, helping 42,763 PLHIV (Ministry of Public Health 2011). This joint collaboration between PLHIV and hospital staff as "co-service providers" is evident in many hospitals. Peer leaders and volunteers take major roles in providing information and understanding of ART, counselling, group activities, and home visits, to ensure the efficacy of the ART and the ability for self-care of PLHIV. These peer-leaders and volunteers also need training and human resource development.

The major evolutions which groups of community workers and civil society organisations have undergone, as well as driven, during the past two years have resulted in clear benefits for standards of care and treatment under national healthcare coverage. They have led to increased access to ART and the diagnosis and treatment of opportunistic infections, with a consequent reduction in morbidity and mortality (Ministry of Public Health 2010c).

Other strategies, in the national plan employed by the government to deal with the skills gap, include shaping the skill mix, increasing the use of staff at rural healthcare centres and reforming the health system by transforming rural health care centres into sub-district hospitals (Noree T, Chokchaichan H and Mongkolporn V 2005; Thammarangsri T 2004; Thammarangsri T 2005; Wibulpolprasert S 1999; 2002; Wibulpolprasert S and Pengpaibon P 2003). Accordingly, the alternative ART delivery model, using the task shifting and decentralisation approach, has been expanding in paediatric care since 2004. The alternative model originated in recognition of the shortage of paediatric doctors at community hospitals. Chiang Rai regional hospital (in the northernmost region of Thailand, bordering Myanmar), supported by the AIDS access foundation (a local NGO) and the joint activity of the Ministry of Public Health, Thailand, and the US Centers for Disease Control and Prevention, became a model for training general practitioner doctors and healthcare providers in other community hospitals to treat children, and enrol those with stable clinical outcomes from ART to receive drugs at their community hospitals.

All these referred children are followed-up half-yearly at regional hospitals. The government expanded the alternative care model from one province, and by 2008 it covered 14 provinces (Hansudewechakul 2004; Jirawattanapisal et al. 2008). In 2010, this alternative care model was integrated into the national program of ART quality of care, with the aim of expanding this effective model to cover all the provinces (Ministry of Public Health 2011).

The ART delivery services are available at community hospitals (district hospitals), but not yet at all sub-district hospitals. There are 9,762 rural health centres covering all sub-districts (Tambons), each serving an average population of 5,000. Since September 2011, all these centres were transformed into sub-district hospitals, now known as sub-district health promotion hospitals[17].

A multi-disciplinary team, including nurses or other medical practitioners, health officials and physical health volunteers, share the care of patients in the sub-district hospitals (Benjakullaya 2012; Klinbuayam 2012; Sithisak 2012; Somrin 2012;

[17] The aim of having sub-district hospitals is to reduce congestion at large hospitals and redirect people to their local hospitals.

Thakumta 2012; Tunkham 2012). This is a major turning point in public health and the development of healthcare systems in Thailand (Ministry of Public Health 2010a).

Task-shifting of ART services has been extensively employed at Sanpatong community hospital in Chiang Mai province, which has the second highest number of PLHIV receiving ART services in the country (National Health Security Office 2011). ART services have been transferred to the sub-district hospitals in Sanpatong district. Since 2008, this hospital has been a pioneer of task shifting ART for PLHIV with a stable clinical outcome of treatment to healthcare providers at health centres in Sanpatong district. The mixed-skill approach was applied to the provision of ART in sub-district hospitals by multi-disciplinary teams including nurses, medical practitioners, health officials and physical health volunteers. However, the sub-district hospitals needed technical support from medical doctors, pharmacists and laboratory technicians at the district hospital for the follow-up processes of measuring clinical outcomes, detecting possible adverse drug reactions, and measuring CD4 count and viral load. These take place when PLHIV have been on ART for 6 months (Klinbuayam 2012; Thakumta 2012).

2.7 CONCLUSION

The review indicates that the HIV/AIDS epidemic has generated, and continues to generate, significant impact to healthcare systems worldwide, by increasing the demand for treatment and care services from increasing numbers of PLHIV accessing ART services under the UC policy. Moreover, the change of enrolment criteria also allows more PLHIV to access services, by allowing those with high CD4 counts to be treated. These changes increase the need for the health workforce, which is the main focus of this study. Furthermore, the changes in healthcare infrastructure, restructuring healthcare centres across the country into sub-district hospitals, must be considered in HRP for ART services. Balancing supply and demand in the health workforce is important in order to solve staffing problems, and different methods of human resource planning are used in the context of ART. In the Thai health workforce situation, the government has alleviated the major problems of mal-distribution and shortages ofhealthcare providers.

Different characteristics or adaptations of ART models were found in countries across the world, possibly linked to their human resource situation. However, they all applied variously-effective strategies to health workforce planning, which could be interpreted as being appropriate to their own contexts and available resources. In the ART service element of the Thai healthcare system, which follows the national practice guideline of the mixed-comprehensive model, the recommended healthcare team comprises doctors, nurses, pharmacists, counsellors and laboratory technicians. ART service tasks from the national guideline are illustrated, and the adaptive model of ART service used is presented.

For HRP, there is a need to balance demand and supply of service providers. Problems of shortages and over-supply are reviewed in this chapter. Several strategies and tactics are used to achieve the desired balance. There are many estimation tools that can be applied for HRP purposes. The tools used in this study were developed from a combination of the mathematical method and HRH estimation tools, including WISN and QTP.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGIES

3.0 INTRODUCTION

This chapter describes the framework adopted for the research design, and the levels of analysis used to achieve the aims and objectives. Section 3.1 discusses case study research. Section 3.2 details procedure and timeline. Section 3.3 presents the data collection process, the instruments used in the study, the procedure used. The direct observation, structured interview and open-ended question interview, as processes of data collection are explained; and an application of the qualitative research approach, used in the process of data collection, is introduced. Additionally, the data collection process for secondary data is indicated. Section 3.4 indicates how the data was analysed and interpreted, and how Markov and uncertainty analysis would be used as tools for projection. Section 3.5 explains quality assurance: validity, reliability and reflexivity. Ethical considerations are discussed in Section 3.6.

Research questions

1. How do hospitals in Thailand, at all four levels of care, deliver ART services?

2. What adaptations to the models of ART service appear to be feasible, to increase access to, and coverage of, ART services, whilst maintaining and improving accessibility and quality of care?

3. Would a newly developed tool be able to be applied to estimate future requirements of the health workforce for ART service delivery?

4. What will be the requirements, capacities and gaps in human resources in the ART delivery service at the four different levels of care during the period from 2012 to 2025?

3.1 METHODOLOGY

To answer the research question about how the selected hospitals adapted their ART models to deliver services, and details of the requirements, capacities and gaps for the health workforce in delivering it, the selection of the methodology, and the design of methodsof data collection, analysis and interpretation, were challenges to the researcher.

The research method required the establishment of priorities. There are about five methods commonly used in the social sciences; experiment, survey, history, archival analysis and case study, depending on the research questions. For instance, the "what" question is exploratory, which can use the survey method to answer the research question. "who" and "where"questions can use survey or archival analysis. By contrast, to answer "how"and "why"questions: these are explanatory, suggesting the use of a case study research method (Yin 2014). In my study, to answer the main research question "how" selected hospitals adapted their ART delivery models to provide ART services while maintaining/increasing quality of care, the case study research method was indicated.

3.1.1 Case study research

A case study aims to answer specific research questions; naturalistic case study research is not conducted under the laboratory conditions of the natural science research style, which usually has some expectations about the results. In order to find answers to the research questions, the study design needed to be carefully and comprehensively developed. Case study is one of several ways of doing social research. To choose an appropriate method depends on the research question. In general, a case study is the preferred method to answer how and why questions (Creswell 2014). For the research questions of this study, there was a requirement to find out how the selected hospitals adapted their delivery models to provide ART services, while maintaining/increasing quality of care. In a case study design, the researcher has little control over events or data that are colletcted; moreover, case study focuses on a real-life context. In this study, the researcher collected the data without any control of events, but investigated the ART delivery service existing in the study locations.

The 'case' in a case study can be the context of the case within its environment, a programme, a system, an event, an activity, or a range of topics. It can be incidences of cultural behaviour or facts (Creswell 1997). It is unique; can be a single case, or a collective study of more than one case (Stake 1995). The design of case study has been defined from a variety of aspects; it has been summarised as an object of study (Stake 1995) and a methodology (Merriam 1988). Creswell explained it as an exploration of a system, bounded by time and place. Gillham (2000) defined it as evidence which could be derived from an individual or a group, and refers to two different research styles; naturalistic-sciences and naturalistic research styles.

The former represents an experimental study to achieve results, as in a scientific experiment, and the latter aims to generalise findings. Yin (2014) similarly identified two features of a case study: it investigates/understands a real-world case, but also looks for phenomena or contexts which may not be evident in real-world situations; for instance, the case study I conducted required more variables, and relied on multiple sources of evidence. This case study is a real-world case, which is naturalistic research. The data were collected in the existing events without any control from the researcher which differed from the natural science which needs to control the environment as laboratory. In a naturalistic case study, the subjects are intrinsically seen as partners in the investigation.

The other main point, which distinguishes these two styles of case study, is the specificity. Natural science research forsees the generalisibility of the findings. It studies existing literature and analyses existing results, supporting its analysis with appropriate theories. The results of this kind of study can be tested by the same experimental procedure to ensure the validity and reliablity of the existing theory: it has a deductive characteristic. However, in the case of natural research, there may not be enough theory and data in the existing literature. Research begins with a review of the context of the research question, and investigation to explore and explain what has been found, using an inductive theoretical perspective (Creswell 1997). Naturalistic research is rich with subjective perspectives; however, it also displays an objective perspective, because it includes investigation of what people do, show and perform, for instance, investigation of participants' roles and activities (Yin 2014). For these reasons, I chose the naturalistic method.

From the literature review and information given above, the natural case study is the core value of my research design: that findings from the cases studied are meaningful and will generate applications. The strategy is the need for deep exploration and explanation during the process and activities of a programme of research (Creswell 1997; Gillham 2000; Stake 1995; Yin 2012; Yin 2014); it is also bounded by time (Creswell 1997; 2009a; 2009b; 2014; Gillham 2000; Yin 2012; 2014). This study aimed for an explanation of a group of activities, using only the research tradition of case study: “ART services’’, that healthcare providers deliver to PLHIV, in the contexts described at the beginning of this chapter. This naturalistic case study research allowed me to retain a real-world perspective, while studying the tasks and activities of ART services, task allocations and the flow of services in the explanatory phase. Case study research is also an appropriate strategy for the deep exploration of a programme, activity or process (Creswell 2014; Creswell 1997; Creswell 2009; Creswell 2009; Gillham 2000; Yin 2012; Yin 2014), which makes it suitable to achieve the objectives of my study. It also has a deeper meaning, beyond exploratory strategies. Yin refers to studies displaying explanatory characteristics (Yin 2014); firstly, a single case study published in 1962, which was a political science best seller (Allison 1971; Allison and Zelikow 1999). It presented three theories to explain the Cuban Missile crisis, during which a US-Soviet Union confrontation nearly led to global nuclear war. In 1999, post-cold war studies of international foreign policies research showed how a single study could be the basis for momentous generalisations (Allison and Zelikow 1999). Secondly, Whyte presented a case study, ‘’Street Corner Society’’, which described a sub-culture of lower income youths and their sequence of interpersonal events. The study was carried out in a small urban area, but generalised the issue, even though it was generated from individual actions, group structures and the social structure of a neighbourhood (Whyte 1995). So multiple scenarios are more likely to generate a more generalised explanation.

In order to investigate exactly what activities healthcare providers conducted in the delivery of ART services, I needed to investigate what they did, listen to what they said, and be able to ask them questions about the flow and linkage of ART activities, and, for clarification, how they organised their tasks. Referring to this study, with the selection of all four levels of care for investigation, in order to generalise and make recommendations at policy level, there was enough evidence to support the belief that a case study, even that derived from one case only, could be used to generalise. The first level of care, regional, offers tertiary care facilities and services at 25 hospitals, 6 medical school hospitals, and 48 specialised hospitals. The second level of care, provincial, consists of 69 general hospitals covering 83.6% of all districts, and 284 municipal health centres. The last level, sub-district, the level of care closest to people in their own local areas, is composed of 9,762 health centres, covering all sub-districts.

3.1.2 Mixed-method approach

The origin of mixed-method research dates back to 1959, when Campbell and Fiske conducted a study which actually used only quantitative measures, but both quantitative and qualitative methods of data collection (Campbell and Fiske 1959): these methods complemented each other, allowing deeper exploration and explanation (Tashakkori and Teddlie 2003). Many study designs come under the heading of mixed-method research, having specific forms or methods which depend on the way in which the quantitative and qualitative are integrated in terms of phase, method of interpretation, and complexity. For instance, in the convergent-parallel mixed method, quantitative and qualitative data, collected at the same time, are merged to generate a comprehensive analysis. In the explanatory-sequential method, quantitative research is conducted first and qualitative research second; conversely, in the exploratory-sequential method, the qualitative is conducted before the quantitative research. There are three other advanced forms of mixed-method research; transformative, embedded, and multiphase, each of which are suitable for a variety of different purposes.

Mixed-method research is categorised as a pragmatic epistemology; pragmatism, which has been applied to research since 1990 (Cherryholmes 1992), is problem-based research, concerned with what works and what will solve a particular problem. Many methods and procedures are chosen to collect and analyse data, the choice being based on what will suit the purpose best.

Many opinions are put forward concerning the most appropriate methods to research issues of healthcare provision. Some suggest the quantitative approach because it is more reliable and generalisable (Brannen 1992). Others argue that the qualitative approach to social research is better than the quantitative because it provides insights which are not available from the surveys used in the quantitative method (Foss and Ellefsen 2002). A third group argues that no single method or even combined methods can capture all the complexity of a real context (Foss and Ellefsen 2002).

Figure 3.1 presents the basic elements in my research design, starting with pragmatic epistemology as a theoretical perspective, combining both a qualitative and quantitative approach to data requirements. The mixed method used in this study allows for variety in the processes of data collection, analysis and interpretation, from both quantitative and qualitative methods. This diversity in data analysis and interpretation supports a pragmatic theoretical perspective as the episteomology, in order to solve the problem of ART service workload and performance in programmes of HIV/AIDS treatment and care.

Figure 3.1 The basic elements of the research design

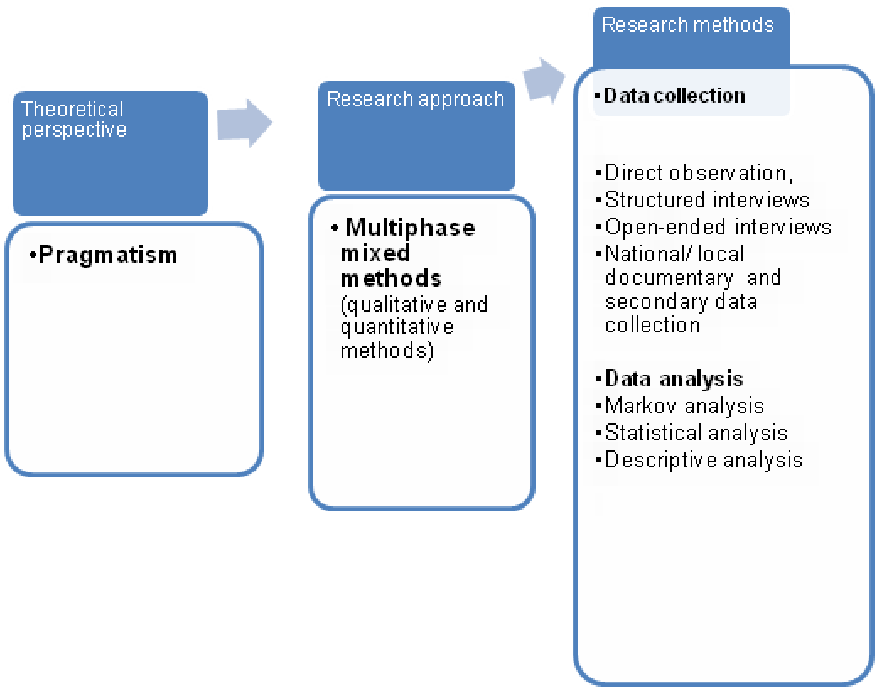
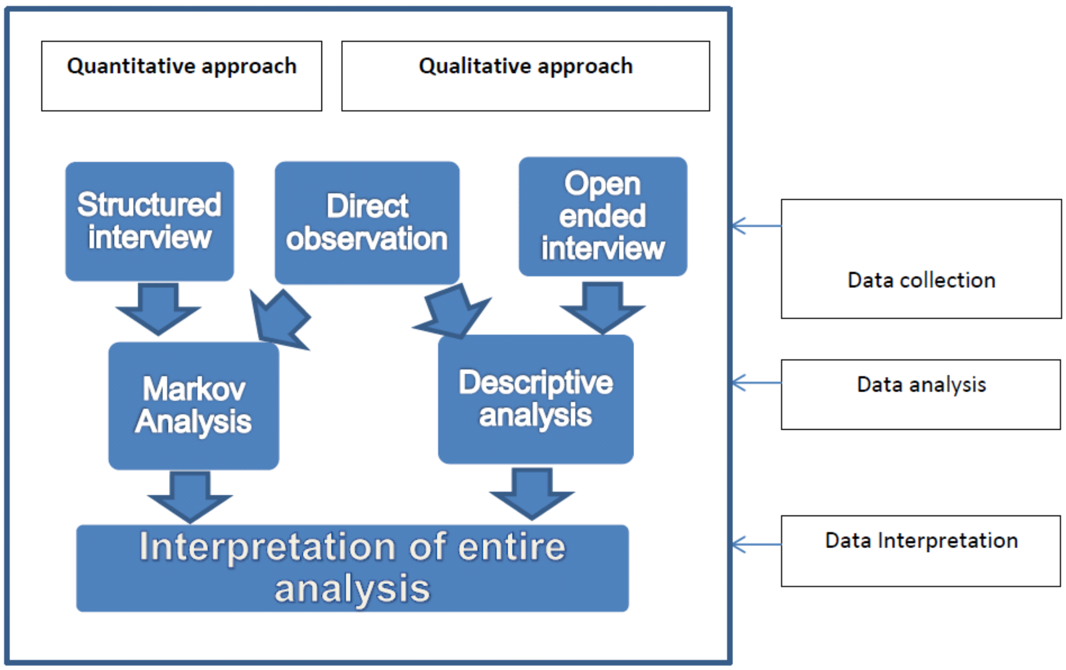


Figure 3.2 demonstrates the relationship, within the study design, linking quantitative and qualitative approaches to data collection and management, which were applied because of their suitability to the multi-phase mixed-method approach.

Figure 3.2 The conceptual framework of multi-phase mixed-method research



The quantitative data are mainly quantitative registry data, statistical analysis of the national data base system, and Markov model analysis to simulate (estimate) the future time requirements to provide ART services. The prognosis is a set of possible consequent transitions between disease statuses, over a series of discrete time periods (Briggs et al. 2011; McPake et al. 2013; Norris 1997).

3.1.3 Qualitative approach

Qualitative research aims to explore and understand the meanings of social and human problems, individually or as a group. It has a worldview of constructivist epistemology (philosophical worldview), (Creswell 2009; Crotty 1998; Lincon and Guba 1985).

Constructivism looks for complexity of view rather than narrowing meaning; interpreting the phenomena. Qualitative research involves a variety of studied areas and empirical materials (Creswell 1997; 2014; Morgan 2007; Ritchie 2004; Silverman 2005; 2011); for example: histories, life stories, organisation, the experiences of individuals or groups of people, case studies, interactional processes.

The goal of the constructivist or social constructivist approach relies on the participants' view of the situation that is being studied. Research questions are broad, to allow participants to answer the question simply, or to explain the situation in more detail. Usually, open-ended questions will be applied during the initial process of this method (Creswell 1997; Crotty 1998; May 2001; Silverman 2001; 2006; 2011). This provides more opportunity to elicit deep information. There is a subjectivist perspective, where meanings are social or historical: not usually individual, but representing interactions with other people or groups (social constructivism).

Some researchers (Creswell 1997; 2014; Creswell 1997; Flyvberg 2006; Foss and Ellefsen 2002; Morgan 2007; Ritchie 2004; Silverman 2001) agree that qualitative research design requires time and resources, which could be accompanied by quantitative researches. It commits researchers to spending time in fieldwork to obtain the necessary data and an inside perspective. It is a time consuming process, particularly for data collection, but also for data analysis; therefore, attempts may be made to limit the quantity of data to be collected in some parts of a study.

Qualitative research investigates the processes of interaction between people; for instance, studies on the cultural settings of participants (Crotty 1998). Researchers gather data, investigating the backgrounds of study participants, as well as their historical or cultural norms and experiences, with the intention of interpreting the meanings and understandings people have about the world, and how they develop theories or meanings inductively in their natural settings.

The holistic picture of the study situation is explored, using a complex narrative with multiple dimensions of complexity (Creswell 1997), without specific procedures or guidelines, in order to participate in social and human science research. Researchers act as active learners who explore the story from the viewpoint of the participants, in their own environment/setting.

Qualitative research has different theoretical uses; generally, for the explanation of behaviour and attitudes, but also for other perspectives, depending on the questions posed by the study and the different contexts of the participants. Whatever the perspective of this approach, researchers start with a similar process: data and detailed information is collected from participants and categorised into themes. The next phase is to develop these themes into broader patterns, theories or generalisations which can be compared with existing literature or people's experiences. However, the end points of a qualitative study vary; for example, it can be interpreted to determine the feasibility of a course of action, or generalisations may be drawn (Stake 1995); some end points may not correspond with or elucidate any theories (Creswell 2014).

3.1.4 Quantitative approach

The quantitative research approach represents a more objectivist epistemology (Creswell 2009a; Crotty 1998; May 2001). This positivism is the element in social research (Creswell 2009; Crotty 1998) which searches for effects, outputs and outcomes (Creswell 2009; May 2001); in the definition of some researchers it is called the scientific method (Balnaves and Caputi 2001; Creswell 2009b; 2014; Michel et al. 2010; Morgan 2007), it is reductionist because it is intended to reduce ideas to the simplest trend, deductively.

The quantitative approach has been discussed from a variety of positions and identified as having a variety of characteristics. For instance, absolute truth can never be proved in data collection, and data as evidence in research are not always complete; therefore, a quantitative study does not prove a hypothesis; however, it will attempt to explain failure to reject a hypothesis (Phillips and Burbules 2000).

The research questions of a quantitative nature are answered by observations recorded by the researcher, and objective measurement of real things that actually exist. Most quantitative research aims to test a law or theory using the scientific method (Creswell 2014; Phillips and Burbules 2000). In practical terms, the researcher collects the data and information, with an instrument to test, and confirm or reject the theory or hypothesis, rather than developing it. The data and evidence of a quantitative study can shape knowledge; therefore, in order to be objective it is important that researchers conduct their research with guaranteed standards of validity and reliability.

The variables in quantitative research indicate the attributes of an individual or an organisation to answer a research question or to make a prediction of an expectation (hypothesis) of the result.

3.2 PROCEDURE AND TIMELINE

The multiphase procedure of this study was applied bring together the processes of data collection, data analysis, and interpretation by both quantitative and qualitative methods. The qualitative method comprised the processes of data collection by structured and open-ended interviews, and by direct observation. The data was then analysed qualitatively. On the other hand, the quantitative data consisted mainly of registry data, statistical analysis of data from the national database, and data of the times required to provide ART services, drawn from direct observation and subjected to Markov analysis. The last phase consisted of interpretation of qualitative and quantitative data.

To specify the population explored in this study, I purposely chose the public sector. From the literature review, the public sector representedover 75% of total hospitals in the country (Ministry of Public Health 2010b). I included only provinces with a high prevalence of HIV/AIDS, on the assumption that this would be reflected by a high demand for ART services. This would provide opportunities to see the resulting increased workload, compared to places with low HIV/AIDS prevalence. The data record for the National AIDS programme (National Health Security Office 2011b), shows that except for the Bangkok metropolitan area, most PLHIV are located in tourist areas in the provinces. In the northern region, two provinces; Chiang Mai and Chiang Rai, had the highest number of PLHIV in the country: 8,732 and 7,984, respectively. The region with the third highest number of PLHIV was Chonburi, in the east, with 5,876; Table 3.1.

Table 3.1 Numbers of PLHIV in high HIV/AIDS prevalence in Thailand in 2011

Province	Number of PLHIV
Chiang Rai	8,732
Chiang Mai	7,984
Chonburi	5,876
Nonthaburi	5,360
Khonkhan	4,973

Note: total numbers in 2011: 149,123 PLHIV

3.2.1 Site selection

While choosing site selection, I had the opportunity to consult with a group of 15 researchers, health system experts and my independent supervisors in Thailand. The objective of the meeting was to sharpen my research planning and to explore the possibility of conducting a field work study, subject to obtaining approval from the university ethics committee. One point identified at this meeting drove the choice of site selection: one community hospital, Sanpatong in Chiang Mai Province, had begun, in 2005, delegating ART services to the sub-district hospitals in Sanpatong district, and had completed this process by the end of 2011 (Klinbuayam 2012; Thakumta 2012). This hospital had referred over 120 PLHIV, with stable clinical outcomes to ART treatment, to receive these services at one of the 11 sub-district hospitals. Another reason for my choice of hospitals, apart from the high prevalence of HIV/AIDS, was the fact there were two where pharmacists rather than doctors took responsibility for screening patient treatment profiles, and conducted meetings of the healthcare team before and after patient visits. These two hospitals were Prachuap Khirikhan and Chaiyapum, which had been developing these care models since 2009. I regularly receive up-to-date information of this kind, fundamental for planning my research, through my background as a board member of an pharmacist initiative group for PLHIV.I monitor this information, and the activities of the PIPHAT group via http://piphat.thaihp.org[18] (Pharmacist Initiative for Patients Living with HIV/AIDS (PIPHAT) Thailand2012).

The PIPHAT group explored and evaluated Samutsakorn hospital to see if it was suitable as another site for this treatment model, where pharmacists could take the lead in organising the HIV clinic. However, in 2012, only Prachuap Khirikhan Hospital was found to be ready, to be a site for training other hospitals, pharmacists and healthcare providers. Training commenced in May of that year. Prachuap Khirikhan implemented an innovative model of ART services, adapted from the standard model described in the practical guidelines of the ART programme, which recommends a doctor-led model of care (Bureau of AIDS, TB, and STIs 2004).

The mixed-comprehensive model of care at Prachuap Khirikhan hospital represents the task-shifting approach, as well as utilising mixed-skills among healthcare providers in the same hospital. However, there are some differences between the Prachuap Khirikhan model and the Sanpatong model. Sanpatong Hospital shifted ART service

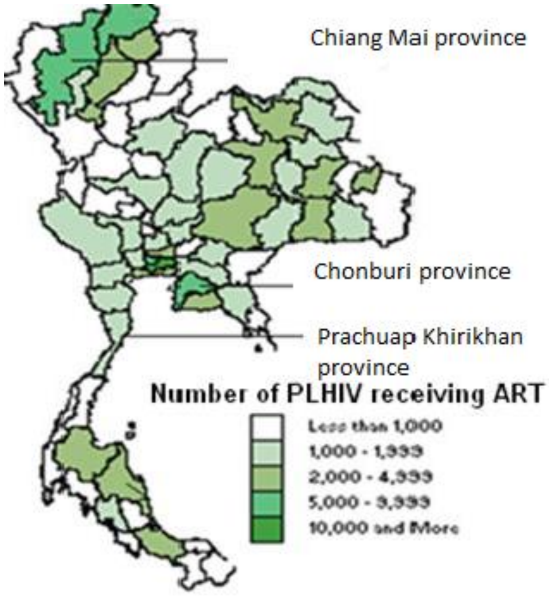
[18] Pharmacist Initiative for Patients Living with HIV/AIDS (Thailand) pioneered by myself and two other pharmacists, set up a voluntary pharmacist organization at the national level, aiming to update knowledge of HIV/AIDS treatment for pharmacists and other interested healthcare providers and enhance their ability to support the healthcare system in addition to their official role of drug prescription.

tasks between healthcare providers in the hospital itself, and between the hospital and the sub-district hospitals in the Sanpatong district; whereas Prachuap Khirikhan only shifted ART tasks among healthcare providers within the hospital itself.

The last aspect that I considered for the choice of site selection was the level of care. The Thai healthcare system provides healthcare at four levels; regional, provincial, community and sub-community, representing tertiary, secondary, community and primary care, respectively (Ministry of Public Health 2010b). All rationales had to be considered, to ensure thatthe selection of hospitals covered all levels of facilities of care. Using all available documents concerning the high prevalence of HIV/AIDS in those provinces, the consultation meeting, and enlisting the participation of PIPHAT, I selected hospitals in three provinces as sampling sites: Chonburi and Chiang Mai provinces, with the highest number of PLHIV after Chiang Rai Province, and Chonburi hospital, which was selected to represent the regional (tertiary) level of care for Chonburi Regional hospital. For Chiang Mai province (to represent the lower level of facility: Sanpatong disctrict hospital and sub-district hospitals in Sanpatong district), representing the community level of facility services, were selected. The last province that was selected was Prachuab Khirikhan province which represented the secondary level of care (provincial facility level of care). The three provinces where the selected hospitals were located is presented in Figure 3.3.

1) Chiang Mai Province
2) Chonburi Province
3) Prachuap Khirikhan Province

Figure 3.3 The three provinces where the selected hospitals are located



In Chiang Mai province, I selected Sanpatong hospital because of the high number of PLHIV receiving ART services (about 1,000), and because it had shifted ART service tasks to sub-district hospitals, as was established at the consultation meeting. I wanted to investigate how ART services were provided in this adaptive model of care; Sanpatong hospital to represent the community level, and the sub-district hospital in Sanpatong district to represent the primary level of care.

The last hospital included was Prachuap Khirikhan Hospital, representing the secondary level of care. Information from PIPHAT showed that Prachuap Khirikhan had adopted a mixed-skill and comprehensive model of ART services.

Chiang Mai Province: Sanpatong hospitals and three sub-district hospitals

From the processes of generating and revising research questions, objectives, and methodology, it was decided to conduct the field work study at seven hospitals for the reasons given in Section 3.2.1. The first chosen was Sanpatong district (community) hospital, Chiang Mai City, Chiang Mai Province. Chiang Mai city is the largest and most culturally significant city in northern Thailand: Figure 3.4. The province has over 20,000 PLHIV, the highest number after the first province (Chiang Rai) in the north of Thailand (Ministry of Public Health 2010c).

Figure 3.4 Map of Chiang Mai province and Sanpatong district

Chiang Mai is sub-divided into 25 districts (amphoe). The districts are further sub-divided into 204 sub-districts (tambon) and 1,915 villages (muban). Sanpatong is a provincial satellite town, approximately 30 kilometres south of Chiang Mai. The district is divided into 11 sub-districts which are further sub-divided into 122 villages.

The hospital is a community-level facility with 120 beds. It has a community home-based care programme, providing health services at family level. The ART programme was a very active core programme, following the national decentralised policy. At the time of the study, it had provided ART services to over 1,000 cases of PLHIV. The hospital ran an HIV clinic, which saw about 30-40 PLHIV a day. The study planned to observe 30% of these (Yamane 1973), over two to three weeks: about 300 cases in total.

This community hospital had delegated most ART tasks to each of its 11 sub-district hospitals. About 100 PLHIV were referred to these sub-district hospitals to receive ART services. Due to limited time, 3 of these hospitals (30% of the total) were selected as sites for the study. 10-15 PLHIV from each of these sub-district hospitals (a total of between 30 and 40) were included in the study, the observation taking between two and three weeks. This province was selected for two main reasons: it had a high prevalence of HIV/AIDS, and an adaptive ART service operated in Sanpatong district; doctors shifted tasks to nurses.There was also task-delegation of ART services from the district hospital to sub-district hospitals for PLHIV who had a stable outcome of treatment

Chonburi Regional Hospital

Chonburi province is in the east of Thailand, on the Bay of Bangkok (Figure 3.3); to the west is the gulf of Thailand. The province is sub-divided into 11 districts, which are further sub-divided into 92 sub-districts and 691 villages. The eastern seaboard is heavily industrialized and is underpinned by shipping, transportation, tourism, and manufacturing industries. It is second only to Bangkok in economic importance.

As in Chiang Mai, this province has a high incidence of HIV/AIDS: 5,876 cases in 2011 (National Health Security Office 2011b).

Chonburi hospital is a regional-level healthcare facility with 825 beds. The hospital provides a tertiary level of care, and the staff includes specialists in chronic communicable diseases such as HIV/AIDS. The hospital treats about half the total number of PLHIV in the province receiving ART services: 3,000 cases.

Figure 3.3 shows the number of people infected with HIV and on ART in each province. To plan the time line for the collection of data in this province, I used the same rationale to select a sample size of about 30% of the total number of PLHIV receiving ART in each hospital, in order to give a statistical generalisation of PLHIV (Yamane 1973). Observation took about a month in each hospital. The Chonburi Regional Hospital Ethical committee approved the ethical document on 8 August, 2012 (Annex 9).

Prachuap Khirikan Provincial Hospital

This hospital was selected as representing the provincial level of care in the region, with the third highest number of PLHIV: about a thousand cases (National Health Security Office 2011b), (Figure 3.3). Prachuap Khirikhan is one of the central provinces of Thailand located some 240 kilometres south of Bangkok. The province is sub-divided into 8 districts, which are further sub-divided into 48 communes or sub-districts and 388 villages. This province has a high number of AIDS cases: almost 5,000 PLHIV, especially among workers in the tourism industry and fishermen (Ministry of Public Health 2010c).

As a hospital at the provincial level of care, Prachuap Khirikhan hospital has 300 beds. A key reason for the selection of Prachuap Khirikhan was because pharmacists and nurses took responsibility for the organisation of the HIV clinic. Their most important roles were clinical monitoring and follow up of PLHIV with stable clinical outcomes from ART. Normally, these roles are the responsibility of doctors, but in this model, the doctor supports the pharmacists and nurses as a consultant, and joins the team when they encounter serious illness or complicated clinical outcomes, such as adverse drug reactions or drug resistant situations. This hospital has about 600 PLHIV receiving ART; The study planned to observe 30% of them (about 200 cases) which it was estimated would take about one month (Yamane 1973).

3.2.2 Sample size

To decide on a suitable sample size, it is necessary to know the characteristics and size of the population; the sample must be representative. If the population size is accurately known, then the sample size should be decided using the formulae derived from Yamane (Yamane 1973).

This study required samples from 2 population groups: healthcare providers and PLHIV. For the healthcare providers, the study populations were the staff providing ART services at each selected site. I used a data record form to observe (by structured observation) and check a list of staff cadres who provided ART services: doctors, nurses, pharmacists, counsellors, laboratory technicians and NGO or other volunteers.

To decide on the sample size of PLHIV for this study, threemethods were used to determine a rationale. This study first applied the systematic sampling procedure for the range (Cohen and Manion 1989). The sample size selected was in the range of

100 to 1,000 cases. This study applied the sampling technique for the criteria in the range of 15% to 30% of the population[19]: 30% was selected as the high end for the purposes of calculation. This study also compared two other methods: the sampling table of Krejcie and Morgan (Krejcie, V and Morgan 1970), and Yamane's method to define the sampling of a population (Yamane 1973). The study found no significant difference in the sampling result. The other consideration was a practical one: the time available to conduct the field work study. If 40% or 50% had been chosen, it would have taken 8 to 10 months to observe and collect data from the national database, and conduct other secondary data collecting processes. The sample chosen was considered to be representative of relevant population.

Table 3.2 Sample sizes in the three provinces

Provinces	Total cases on ARV drugs in sampled hospitals	Recorded cases at sampled hospitals	
		Cases	(%)
Chiang Mai	924	308	33.33
Chonburi	3,171	984	31.03
Prachuap Khirikhan	669	235	35.13
Total	4,764	1,527	32.05

From Table 3.2, about 30% of the total number of PLHIV receiving ART services in each hospital were selected as sample groups: 30 PLHIV were the sample size for all three sub-district hospitals; 308 cases of PLHIV were the sample size for Sanpatong hospital, 984 cases of PLHIV were the sample size for Chonburi hospital and235cases

[19] If population is 100 , use a sample size in the range of 15 to 30%; if population is 1,000, use a sample size in the range of 10 to 15%; if population is 10,000, use a sample size in the range of 5 to 10%

of PLHIV were the sample size for Prachuap Khirikhan hospital. In total, about 1,527 cases were observed:

ART clinics at the following six hospitals were studied:

1. Sanpatong District Hospital: located in Chiang Mai province

2. Ban Huorin Sub-district Hospital: located in Sanpatong district in Chiang Mai province

3. Ban Mae-Kungluang Sub-district Hospital: located in Sanpatong district in Chiang Mai province

4. Ban Rongngou Sub-district Hospital: located in Sanpatong district in Chiang Mai province

5. Chonburi Regional Hospital: located in Chonburi province

6. Prachuap Khirikhan Provincial Hospital: located in Prachuap Khirikhan province

As soon as authorisation was received from the directors of the hospitals, data collection commenced. Data was collected from the six sites between 6th August and 25th October, 2012: 1,527 cases from a total of 4,764 who attended atthe six hospitals are included. This achieved a sample size of 32.05%, reaching 30% of expected sample size as needed (Yamane 1973).

3.3 DATA COLLECTION

I used quantitative and qualitative methods of data collection to investigate which models of care were being used to increase the ART delivery service and client flow (PLHIV), and determine how the clinic operated its services. Analysis of task descriptions and distribution, and the time required for HRH to delivery the ART service at community, regional and provincial level was intensively researched.

My design, derived from case study strategy, could be applied to either quantitative or qualitative data collection processes, using a mixed-method approach. The study began with selecting sites or cases by purposive sampling (Creswell 2014; Gillham 2000; Sapsford and Victor 2006); in the second phase, open-ended interviews were conducted to collect detailed views from participants as in a qualitative approach (Creswell 2014; Creswell 1997; Morgan 2007; Ritchie 2004; Silverman 2005). In parallel, direct observation and close-ended data record forms were used to collect data using a quantitative approach (Creswell 2014; Morgan 2007).

Variables in the study:

1) The tasks and activities of the ART service were the independent variables which could cause and influence an effect and outcome. The data record form, presented in Annex 1, aimed to collect mainly data of these independent variables. The data record form was a kind of checklist and consisted of a table with spaces for entering data. This was collected while the researcher observed and interviewed participants, with the questionnaire as a quantitative tool.

2) Data of the sequence and organisation of the particular model of ART service by interviewing participants (who were healthcare providers for ART services) qualitatively with open-ended questions to allow them to answer the specific question of “How ART

services are provided by healthcare workers (from the moment PLHIV enter the hospital until the participants had provided a complete ART service to them? (Annex 6). Each member of the workforce was responsible for their own activities in the provision of ART services. Activity data was a dependent variable. The time required (in minutes) to provide each activity of the ART service was measured, and the activity explored and investigated, using the data record form and open-ended interviews, as with the variables described above. The times required were ascertained using direct observation by the researcher whenever access was possible. The researcher used a wristwatch to measure the time required to provide a particular service by recording two points in time; the start (before PLHIV received ART services) and stop (after PLHIV had received ART services). Some units of care were not accessible to the researcher, so a daily data record form (see Annex 2) was used, to allow healthcare providers to record the time required for their particular activity themselves. The form asked for the date and the name of the ART service unit, and provided a table for recording the starting and finishing times for the provision of the particular ART service. Use of this form was explained by the researcher and healthcare providers were able to ask questions to ensure their complete understanding.

3) Frequencies of PLHIV following up their health status and treatment outcomes was collected by qualitatively interviewing the healthcare workers with open-ended questions, at the same time as collecting the variables in 2). The frequency of follow-up of PLHIV at the hospital was a dependent variable, modified by the dependent variables of flow, organisation and management of the ART model of care, as with independent variable 2).

4) Numbers of PLHIV, projected from the Thai working group on HIV/AIDS (2008), were quantitative variables, retrieved from secondary sources, as available.

5) The numbers of healthcare providers involved in the provision of ART services were quantitative variables, retrieved from national data bases and publications. These were collected by using the data record form, as well as from other secondary sources, as available.

Data obtained by each method was combined, analysed and interpreted, to achieve the objectives of the study: see Table 3.3. The observational study was conducted for all four levels of healthcare: tertiary (regional), secondary (provincial), community (district) and primary (sub-district), using the two main processes of the quantitative method. For the community level, data was collected by direct observation at the community and sub-district hospitals (primary level of care), to which the district hospital had shifted and allocated ART service tasks. Observation at the regional and provincial level was conducted in a similar way. The national practical guideline for ART services in Thailand (Bureau of AIDS, TB, and STIs 2004) recommended having at least five cadres of healthcare workers to deliver ART services at HIV clinics in public hospitals. The main cadres were medical doctors, nurses, pharmacists, laboratory technicians and counsellors. Hospitals could choose additional cadres for these teams, appropriate to their own contexts. The study intended to elicit the time needed for HRH to deliver ART services and project these figures for the period from 2012 to 2025.

Table 3.3 Research methods and objectives of this study

Objectives	Variable	Data collection methods	Data analysis methods
Stage 1: **Objective 1.** To investigate and identify existing models of different ART delivery services from a case study of six hospitals at four different levels of care. **Objective 2.** To suggest how selected how selected hospitals can feasibly adapt their approaches to the delivery of ART services, in order to increase access and coverage, whilst maintaining and increasing accessibility and quality of care.	1. The tasks and activities of the ART service 2. Sequence and organisation of the particular model of ART service	1. Direct observation on site of the task/activities of ART service and organizational (flow) of ART service by using a structured observation with data record form. 2. Interview with open-ended questionnaire to healthcare providers who are heads of unitsat the ART clinic (doctor, nurse, pharmacist, counsellor, laboratory technician) for the task/activities of the ART service and organisational (flow) of the ART service. 3. Structured interview with healthcare providers who are heads of units at the ART clinic (doctor, nurse, pharmacist, counsellor, laboratory technician) for the task/activities of ART service and organisational (flow) of ART service by using data record form.	1. Activity analysis to answer what activities of ART services have been delivered and by whom (what type of healthcare provider) 2. Narrative analysis to answer how the selected hospitals adapted their approached to deliver ART services. 3. Narrative analysis to measure how the selected hospitals adapted their approach to deliver ART services.

Stage 2: **Objective 3.**To develop and test a tool to estimate the requirements, capacities and gaps in human resources, in response to the demands of the policy of universal access to ART services, from 2012 to 2025, by modelling the implications for human resources; varying with an increase in the CD4 count enrolment level from 200 to 350 cell/mm^3, based on evidence from the case study hospitals. **Objective 4.**To generate specific policy recommendations for adapting models of care	1.Frequencies of PLHIV following up their health status and treatment outcomes 2. The number of PLHIV projected from the Thai working group on HIV/AIDS 3. The numbers of healthcare providers involved in the provision of ART services	1. Secondary data collection from results of the stage 2. National Data from the national database 3. Secondary data collected form the PLHIV's records	Markov and Monte Carlo analysis would be used to estimate future requirement, capacity and gaps of healthcare workers to provide ART service

3.3.1 Direct observation and structured interviews using structured data record forms and open-ended interview

Looking and listening are the essential elements of observation (Creswell 2009b; 2014; Gillham 2000; Kumar 2012; Matthew and Carole 2011; Ritchie 2004; Silverman 2005); Gillham's definition, "watching what people do, listening to what they say and sometimes asking them clarifying questions ...", seemed relevant to the design of this study. Direct observation ensures validity because the data accurately represents what participants do, not what they say they do, or what they do as reported by others (Gillham 2000; Yin 2014). It has little effect on the observed subjects and their context; other people can observe the context and participants, thus enabling inter-observer reliability. It is very time-consuming, but highly specific to ascertain key points of evidence, making it particularly useful to this study. As a part of the multi-phase mixed-method approach of this study, direct observation, as an exploratory and explanatory technique, allowed the researcher to both describe and explain the results.

The observation in this study was structured; ART services and participants who were healthcare workers delivering ART serviceswere observed from outside at a specific time, using a pre-prepared data record form,in order to analyse the activities and tasks of existing ART services in the hospitals selected for sampling. The study was conducted using the data record form (Annex 1), to collect data provided by healthcare providers; it was also used as a structured interview questionnaire. The healthcare providers were asked to read an information sheet (Annex 3) until they undertstand the objectives of the study and then they were asked to sign their signatures in the consent forms (Annex 4). The data sets were: ART service activities; the roles of healthcare providers during each ART service activity; the time requirement for providing each ART service activity; and the flow of ART services: the sequence and organisation of the ART service. A digital recorder was used to record the open-ended and structured interviews, to increase the reliability of data collection. The following open-ended interview questions were used:

1. Please tell me, how do you and your team deliver ART service from when PLHIV first arrive at the ART clinic until they leave?
2. How and concerning what do you follow up PLHIV at each visit?

The times healthcare workers required to provide ART services were recorded manually, using a wristwatch, for unit that which could be accessed, excepting the pharmacy unit. The two points of time were recorded: start and stop.

‘Start’ time

The ‘start’ time was the time the PLHIV entered the room where each healthcare unit was; if any unit did not have its own room, the ‘start’ time was recorded when the healthcare provider connected to that particular PLHIV.

‘Stop’ time

The ‘stop’ time was the time when the PLHIV left the room where the unit was located; if that unit did not have its own room, the ‘stop’ time was recorded when the healthcare provider finished providing that particular ART service activity.

Structured observation was used; although time consuming to plan, its transparency in the data collecting process was important. The study had clear objectives and the researcher knew exactly which elements to observe.

In order to ascertain the providers' perspectives, all cadres of healthcare provider were directly observed during activities and task allocations; the sequence or flow of ART services, and the time taken to deliver them, were also recorded, in each hospital: community, provincial and regional.

It was planned to observe at least 15 to 20 members of each of the five cadres of healthcare providers from each level of hospital; in fact, all the ART service providers working at the time were observed. The sub-district hospitals employed only three cadres of healthcare providers, but the possibility existed for part-time doctors and pharmacists from community hospitals in the area to support them. These healthcare providers were observed in the same way as the subjects in the community and regional hospitals. In total, 43 healthcare providers were participants in this study. Annex 5 presents the number and demographic information of participants who were observed, interviewed and participated in time recording (for the pharmacy unit). In the 6 hospitals, 6 physicians (doctors), 9 nurses, 10 pharmacists, 4 pharmacy technicians, 3 counsellors, 3 laboratory technicians and 7 non-healthcare providers (volunteers or NGOs) were recruited as participants (Annex 5). The interview protocol of structured interview and open-ended interviews are presented in Annex 6.

ART service activity data was collected from direct (structured) observation and structured and open-ended interviewed questions, derived from the national practical guideline (Bureau of AIDS 2004), as described in Chapter one and adapted from the Management Science for Health and World Health Organization (Management Science for Health and World Health Organization 2006). The main activities are specified depending on three groups of patients; treatment initiation or new case, follow up without complication and follow up with complication. The data record form (Annex 1 part 2) shows the information it was planned to collect (Bureau of AIDS, TB, and STIs 2004).

The model of ART services provided at each site was observed, and the task allocations of ART services and client flows of these models of care were analysed. The time required by each provider to provide each element of the ART services was also recorded, as one of the objectives of the study.

Formal letters (Annex 7) were prepared and submitted to the six hospitals chosen for data collection. This was the first formal contact; the researcher had previously contacted them informally to introduce herself, the purpose of her research, and her work plan. After their agreement a formal letter was sent requesting authority to collect data from each hospital. After ethical approval was received from Queen Margaret University (Annex 8) on 18th July, 2012, to proceed with the fieldwork study, approval was sought from the ethical committee of each hospital, as needed. There was no requirement for ethical approval at national level as the study wasnot conducted under the authority or financial support of the Ministry of Public Health. Ethical approval was at the discretion of the individual hospital. Only Chonburi Regional Hospital required approval from the ethical committee (Annex 9) because of their regulations. At the other hospitals, permission for data collection was granted by the director.

Following approval, field work began on 6th August, 2012 at Sanpatong District Hospital. The researcher spent two weeks there, and one week at each of the other three sub-district hospitals. Next, ART activities at Chonburi Regional Hospital were observed for approximately a month, then at Prachub Khirikhan Provincial Hospital for approximately a month. Hospitals were visited in the order in which ethical approval was obtained.

The fieldwork study took about four months in total. Data was collected from the national database during November, 2012, data collection from the fieldwork study having been completed at the end of October. A director of the National AIDS and Tuberculosis funds and the National Health Security Scheme (which currently covers 70% of the population, with a target of universal coverage) provided the study with the national electronic data files. Data was also collected from both Thai and English publications, including grey literature such as reports, and electronic data bases and publications.

As the last task of the study, data was cleaned and prepared for analysis. Raw data was entered into electronic files and cleaned. The cleaning process included correction, collection of missing data and confirmation with healthcare personnel at each hospital. The personal contacts of all healthcare providers connected during fieldwork were retained, allowing the opportunity to confirm data by several means of communication. It was possible to complete the data cleaning process efficiently. Hard copies of the raw data were kept in a secure locker which could only be accessed by the researcher, guaranteeing data confidentiality

3.3.2 ART activities

Health status 1: Treatment initiation

During this initial phase of treatment, all PLHIV receive many services from healthcare providers.

1.1 Screening of symptoms

The first activity that new cases of PLHIV receive from the ART service on entering the HIV clinic is registration and screening of symptoms. This activity is provided for all PLHIV, regardless of health status. The study defines these activities as ART services management. Other activities that can be included in this activity category are making new appointments for follow-up, maintenance of data records and patient profile management.

1.2 HIV/AIDS counselling before starting ART

After PLHIV are informed of their HIV positive status, they have the right to access ART. HIV/AIDS counselling is the main ART activity at this inital stage, as recommended in the national practical guideline (Bureau of AIDS, TB, and STIs 2004). This is to promote commitment by patient and doctor to ART, because once the PLHIV has started ART, they must continue taking the drugs with good adherence, and must visit the clinic regularly, to receive more drugs and follow–up their clinical outcomes from the treatment.

1.3 Laboratory testing for clinical status

PLHIV need to undergo basic laboratory tests at the beginning of their treatment. These tests are recommended in the national ART guideline (Sungkanuparph et al. 2010), and include liver function tests, kidney tests, blood tests and CD4 count measurement. Moreover, they receive tests for opportunistic infections including tuberculosis, Pneumocystis, Pneumoniasis (PCP) and Cryptococcal meningitis. Results of these tests are necessary information for the assessment of treatment: PLHIV have to be treated and receive prophylaxis for any opportunistic infections before or during the time that they are receiving ART services; decisions are made by the healthcare team at the clinic, depending on the patient's clinical status.

1.4 Treatment initiation with opportunistic prophylaxis and ART therapy

After the counselling process, which allows PLHIV to receive useful information, make necessary decisions, and commit to starting ART, they receive more information about the ART drug regimen and related information about ART services, including the advantages, disadvantages, and any potential risks of the treatment that may occur. They have to be made aware that once they start ART, they will have to take it for the rest of their lives, with good adherence, so that they do not become drug resistant. When they have made the decision to start ART, they will receive opportunistic infection prophylaxis and treatment, and then ART. They will also make an appointment for the next visit to follow up the clinical outcome of the ART.

1.5 Drug dispensing

After initiation of treatment: prophylaxis and treatment of opportunistic infections and ART, PLHIV receive the services of drug prescription and counselling for treatment and prophylaxis of opportunistic infections and anti-retroviral drugs. Information about indications, contra-indications, drug interactions, adverse drug reactions and drug resistance is given to PLHIV. After this they receive the drugs to take at home.

1.6 Counselling for drug adherence

Once PLHIV have started ART, good adherence to the drugs is essential if drug resistance and the consequent necessity for a change or even termination of regimen are to be avoided; PLHIV are expected to commit to good adherence, and are counselled to this effect. Adherence is evaluated by the ART healthcare team and PLHIV are supported, using a variety of techniques, depending on the individual patient and team.

Health status 2: Follow-up without complication

2.1 Screening of symptoms

The first activity that PLHIV following-up without complication receive is the screening of symptoms, as for the other two categories of patient.

2.2 Laboratory testing for clinical status

PLHIV need to be followed-up to ascertain the clinical treatment outcome; the results of laboratory tests carried out at this appointment are compared to the results of the basic tests taken at their first appointment: these are tests for liver and kidney function, and blood tests. The CD4 count test is repeated every 6 months to evaluate the effectiveness of treatment, and contribute to the investigation of toxic reactions, adverse drug events and signs, and the detection ofsymptoms of drug resistance.

2.3 Clinical monitoring

PLHIV are given clinic appointments for following up clinical treatment outcomes, refilling drugs and checking adherence status, as recommended by the national practical guideline; this is particularly important at the first follow-up appointment from the start of treatment (Sungkanuparph et al. 2010). If there is a serious adverse drug event, and/or PLHIV do not show good compliance to the drug regimen, the clinic team considers changing the regimen and treating any reaction that has occurred.

2.4 Drug refilling

PLHIV with stable clinical outcomes and no adverse drug events continue the treatment with the same drug regimen. They receive more drugs, and any information needed concerning indications, contra-indications and how to recognise adverse drug events in the short and long term.

2.5 Counselling and checking drug adherence

PLHIV are counselled on good adherence to ART in the same way as new cases, using a variety of methods appropriate to the individual patient and team.

Health status 3: Follow-up with complications

For this group of PLHIV, all processes are conducted as in the case of follow-up without complications; they receive the ART services of registration and symptom screening, laboratory testing for clinical status and monitoring, drug delivery and counselling. However, PLHIV who follow-up *with* complications receive services that the other two groups obviously do not need. The team considers whether to change the ARV drugs regimen and patients receive more intensive counselling and drug information for the new regimen, as needed.

Changing drug regimens

PLHIV without stable clinical outcomes, or who have had an adverse drug event, opportunistic infection, or who show signs of drug resistance, may be prescribed a new drug regimen, or more drugs may be added to their current prescription. In these cases, patients are in a similar category to those at the beginning of their treatment (initiation), but it is more complicated, because they are on an advanced regimen. Most of these carry more risks of severe or other types of adverse drug reaction, and may be cross-resistant to the antiretroviral drugs that the PLHIV had received before.

3.3.3. Defining task allocations and the time requirement of healthcare providers by direct observations

This part of the data collection was conducted using the quantitative approach. Task allocations were structured and prepared, as seen in the data record form in Annex 1. The tool provided by the World Health Organization, which defines the health workforce as “all people engaged in actions whose primary intent is to enhance health’’ was applied (Management Science for Health and World Health Organization 2006). The health workforce or healthcare workers in the ART programme are the people who provide ART services. ART services have been delivered between HRH in the health system, which includes approximately 30,000 medical doctors, 120,000 nurses, 8,000 dentists, 10,000 pharmacists and a number of other health professionals including laboratory technicians and counsellors (Ministry of Public Health 2010b).

In an HIV clinic, the five cadres of healthcare providers have recommended roles following the national practical guideline for ART services (Bureau of AIDS, TB, and STIs 2004; Jirawattanapisal 2009). Doctors play an important role in clinical diagnosis, and monitoring and prescribing drug regimens; nurses manage the ART programme, making appointments for follow-up, screening health status, and counselling; pharmacists distribute, refill drugs and provide drug counselling, information and advice on adherence; counsellors provide pre-, post- and follow-up HIV/AIDS counselling; laboratory technicians provide tests that investigate and check the patient’s status and outcome. The roles of ART service healthcare providers were categorised using the national practical guideline for ART services and the researcher’s previous study (Bureau of AIDS, TB, and STIs 2004; Jirawattanapisal 2009) which was based on the guideline and the opinion of experts. In this study, however, the ART service activities of healthcare providers were observed in real life, in appropriate sample sizes, lists and percentages for each activity, and task allocations were checked using the data record form, as were the times taken (in minutes) to provide each ART service activity.

3.3.4 Preparing the schedule and management for observations, interviews and data collection

The first priority at the HIV clinics at each of the sampling hospitals was to explain the briefing plan and schedule to the healthcare team. They were interviewed using a structured interview questionnaire which became the data record of the study, as presented in Annex 1. They were also interviewed using an open-ended interview questionnaire, to ascertain details of the model and organization of ART services, including activities, task allocations and the flow of the ART service. Details of each hospital were recorded; their patient demographic; the number of healthcare providers in each cadre providing ART services, and their working hours per day, week and year for 2012 and 2013; numbers of new enrolments per month; numbers of PLHIV receiving ART, waiting for ART and those lost to follow up, their survival rate and number of deaths, until 2012, as the data was available. The researcher decided to collect data concerning the number of PLHIV at each level of CD4 count, as follows: < 50, 51-200, 201 to 350 and over 350 cell/mm^3.

The researcher prepared an observation schedule and the practical tools intended for use in the fieldwork study. Observation of about 50 to 80 PLHIV per day was planned, starting when they arrived at the reception desk and continuing until the last PLHIV had left. When the ART clinic followed a one-stop model, the observation process was managed by the researcher alone, from beginning to end, because healthcare providers delivered ART services to each group of PLHIV at the same time and in the same place. When the HIV clinic was integrated into normal hospital services, along with other chronic diseases, however, PLHIV had to move between each care unit (for example, the pharmaceutical unit or the laboratory unit) themselves, for example to thepharmaceutical unit to receive drugs and drug counselling, and to the laboratory unit to collect blood for testing. It would be possible to have all these units integrated into other services.

In this case the researcher had to prepare and manage observation differently. The five units of care that PLHIV had to visit were listed as follows:

Unit 1. Screening of symptoms

Unit 2. Diagnosis, treatment and clinical monitoring

Unit 3. Delivering, refilling and counselling for Antiretroviral and other drugs

Unit 4. HIV Counselling

Unit 5. Laboratory testing

There were some units that the researcher could not observe personally. Healthcare providers in that unit were requested to record the time taken to provide their ART service activity by recording starting and stopping times. These times were recorded on the daily data record form, as presented in Annex 2.

3.3.5 Documentary data collection

Some literature was not published or publicly available; for instance, the national database and administrative reports. It was necessary to make a direct request to the organisations to whom the data belonged. The two data sets neededfor statistical and Markov analysis were numbers of PLHIV and numbers of healthcare providers.

Data collecting for number of PLHIV

1. PLHIV numbers collected from the National AIDS Programme

The National AIDS Programme received PLHIV numbers from all hospitals, reporting to them at a regional level and passed to the national level on a monthly basis (National Health Security Office 2011b; National Health Security Office 2012a; National Health Security Office 2012b). The programme also collected data concerning PLHIV numbers from all three funding bodies in Thailand responsible for ensuring universal access to ART: these were the National Health Security office (NHSO or Universal coverage scheme; UC), the Social Security Office (SSO) and the Civil Servant Beneficial Scheme (CSMBS).

Due to the efforts of the National Commmittee of the NHSO, the committees have trimester meetings to monitor the progress report of the National AIDS Programme. The researcher participated in one of these meetings before leaving for her Ph.D study, and obtained information about the number of PLHIV in each scheme in 2008[20]. Data was collected directly from the manager of the National AIDS Programme of the NHSO

[20] The percentage of PLHIV receiving ART was highest in the UC scheme at 81.1 %, followed by the SSO and CSMBS with 10.9% and 2.1%, respectively. The three schemes have their own national database which is not available to the public.

(UC scheme), in order toobtainup-to-date information on the number of PLHIV receiving ART, their survival rates and loss to follow-up rates. This national information, combined with the data from the sampling hospitals, was analysed and interpreted by statistical procedures and Markov analysis in Section 3.4 in different assumptions.

2. Number of PLHIV estimated by the projection of the Asian Epidemic model

The Analysis and Advocacy Project (A2) in Thailand, in collaboration with the Thai Working Group on HIV/AIDS, presented the results of the updated Asian Epidemic Model (AEM) Projections for HIV/AIDS in Thailand 2005-2025. These updated projections were prepared to serve the preparation of the development of the Thailand 10th National AIDS Plan (Thai Working Group on HIV/AIDS 2008). The A2 Project projected the number of PLHIV who would be receiving ART between 2005 and 2025. To do this they made several assumptions: serious HIV related illness to death is set at 0.9 years in the absence of ART; symptomatic criteria is assumed to be 0.9 years; the ART programme grows at 1.5% a year; a value of 0.25 was used for the ratio of infectivity of those on ART to those not on ART; PLHIV becoming asymptomatic since accessing care was 3% in 2005, rising to 10% in 2020 (Thai Working Group on HIV/AIDS 2008).

The A2 project used methodology to calculate numbers of PLHIV receiving ART. Infections were calculated using the non-ART version of the AEM, based on behavioural inputs and transmission probabilities that give a match to past prevalence trends in the country. PLHIV receiving ART are assumed to have a lower transmission probability than those who do not, specified by a transmission reduction co-factor at 0.25 (a 75% reduction in transmission of HIV by those on ART). The model posited early recruitment at a CD4 count of <200 cell/mm^3 as a person reached the first line drug regimen (eligible to treat). When they reach the second symptomatic criteria for eligibility, they can be moved into the treatment group. Once they have received first-line therapy, they can follow one of four paths; continue on first-line therapy from year to year; drop out of therapy due to side effects, difficulties in accessing drugs or for other reasons; suffer a therapeutic failure on first-line therapy and move to second-line therapy; and the last path is death. Those who move to second-line therapy can follow the paths of continuing therapy, dropping out or dying.

From methodology and all the assumptions that the A2 made to project numbers of PLHIV from 2005 to 2025, they present the numbers of PLHIV in the following status variants: on ART with first-line or second-line drugs or dead; these figures presented in graphs and numbers used for this study.

National data on the number of healthcare providers

An attempt to create a national human resources for health data source was carried out along with multiple stakeholders: the Ministry of Public Health, professional councils and other health-related organizations; however, there were some barriers which became problems. The information covered all health the public sectors, about 75% of the total health sector in Thailand (Ministry of Public Health 2008a). Other limitations found were duplication and inconsistency of data, and lack of data links, as well as lack of the process or mechanism to manage the data and ensure it is taken into consideration when decisions are made concerning HRH policy and planning (Thamarangsri 2004).

3.4 DATA ANALYSIS AND INTERPRETATIONS

3.4.1 Data analysis

3.4.1.1 Methodological approach to qualitative data analysis

This study adopted the framework approach for data analysis. This is an approach in health and social science research. It is a content analysis method which summarises and classifies data within a thematic framework (Green and Thorogood 2009). This study set the structured interview and data as the framework by generating a data record form (Annex 1). The open-ended interview, structured interview, and direct observation were also conducted to collect qualitative data concerning the tasks/activities of ART services, and the sequence (flow) or organisation of ART service tasks/ activities provided by healthcare and non-healthcare providers were orginally set up as the framework of analysis from the recommendations of the national guideline presented in Section 3.3.2 (Bureau of AIDS, TB and STIs 2004). The data record form would be filled in completely and analysed, following the data that were collected from participants in the interviews, and that obtained by observation.

On the other hand, the data records from the open-ended questions were collected and either transcribed into texts or quoted in the text, to increase the reliability of data analysis. The collected data were transcribed into texts by comparing the hand written notes of the interviews with transcripts of recordïngs. “An accurately transcribed recording is the most reliable record of an interview”, (Green and Thorogood 2009). The organisation and sequences of ART services were analysed and generated into a diagram.

The data recorded from structured interviews, open-ended interviews, and direct observation, were transcribed into texts. This was then analysed and interpreted, mixing qualitative and quantitative to arrive at conclusions, with the potential for generating policy-oriented findings and recommendations.

3.4.1.2 Methodological approach to quantitative data analysis

Quantitative analysis has two components; 1) statistical management for the set of input parameters; and 2) the analysis process of the Markov model.

1) Statistical management for the set of input parameters

From the processes of direct observation and documentary collection, the researcher expected to achieve principal and relative data from the sampling hospitals.

Main required data for statistical and Markov analysis:

1. Activities of the ART service
2. Task allocations and roles of healthcare providers
3. Time required for healthcare providers to deliver ART services
4. Frequency of follow-up appointments at HIV clinics

Related data set:

A. Demand side:

1. Rate of loss to follow-up of PLHIV
2. Number of PLHIV receiving ART in categories of CD4 count levels
3. Number of PLHIV following-up with and without complication.

B. Supply side:

1. Number of existing healthcare providers

2. Number of healthcare providers in the production plan

3. Number of healthcare providers projected into the future

The next step was to manage the data before the analyzing process; statistical analysis was used for this; mean $\pm$ standard deviation and non-parametric analysis, to compare differences among groups of sampling data by the chi-square method, carried out using SPSS software (SPSS, Inc., Chicago, Illinois, USA). The study summarised the characteristics of the cohort using descriptive statistics.

Following this, estimates were produced of the time required for the ART services carried out by each cadre. Findings from the analysis show this in terms of full-time equivalent (FTE) of each cadre, and the total for the sampling hospitals, in 2011. This enabled the calculation of total HRH requirements by two equations (see below).

Differences in ART services were compared at all levels of care facility; regional, provincial, district and sub-district hospitals. The quality of care was compared at each level of facility, with survival rates and rate of loss to follow-up of each.

Equation 1: Time requirement for providing ART service =

mean of sum of time required by all providers

This mean of sum of time required for ART service is defined as "standard time required for providing ART service".

Equation 2: Time required for treatment by each cadre =

Number of ART clients X number of tasks per patient year X standard time required for ART service duration of each task

2) The analysis process of the Markov model

From the calculation and analysis in Section 3.4, the formula to calculate the FTE was used for the linear relationship, which was reliable for the purposes of calculation when parameters were predictable – what the exact number should be, or nearly. Several studies applied equations similar to 1 and 2 to come up with the FTE of healthcare providers in the year in question (Van Damme et al. 2007; Barnigausen et al. 2007). However, they needed to set assumptions which could be used for estimation and projection in the future. In a study to estimate human resource requirements for scaling up ART in low resource countries in 2005, Smith estimated the human resource requirement for achieving the goal of the U.S. President's Emergency Plan for AIDS Relief (PEPFAR); this organisation is the U.S. Government initiative to help save the lives of 2 million PLHIV in 14 countriesby treating them with antiretroviral drugs (Smith 2005). Smith used basic calculation with equation simulation for two scenarios: providing ART services with and without the participation of community workers; the formula used is shown as follows:

> Human resource requirement = (number of patient x annual patient time required for services)/ provider time available to spend with each patient per year.

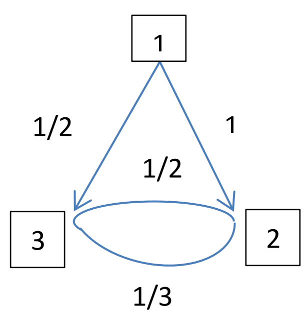
Smith used parameters of the time available for each healthcare worker as 1,000 hours per year, 4 days per week and 5 hours per day. The results showed that community health workers provided ART services with a good quality of care, and reduced the workload of healthcare providers.

A. Principles and properties of the Markov model

The Markov model is a commonly used approach in decision analysis, with a multiplicity of possible consequences. A more complex prognosis is reflected as a set of possible transitions between disease statuses, over a series of discrete time periods (Briggs et al. 2011; McPake et al. 2013; Norris 1997).

Because this study was based on the principle of a chain in discrete time, Markov was a suitable analytical tool; I moved from state I to state 2 with a probability of 1. From state 3, I moved either to 1 or to 2 with equal probability: 1/2, and from 2, I can jump from 2 to itself with a probability of 2/3. But since the total probability on jumping from 2 must equal 1, this does not convey any more in the formula, and we prefer to leave the loop out: Figure 3.5.

Figure 3.5 Markov discrete time model



B. Markov analysis

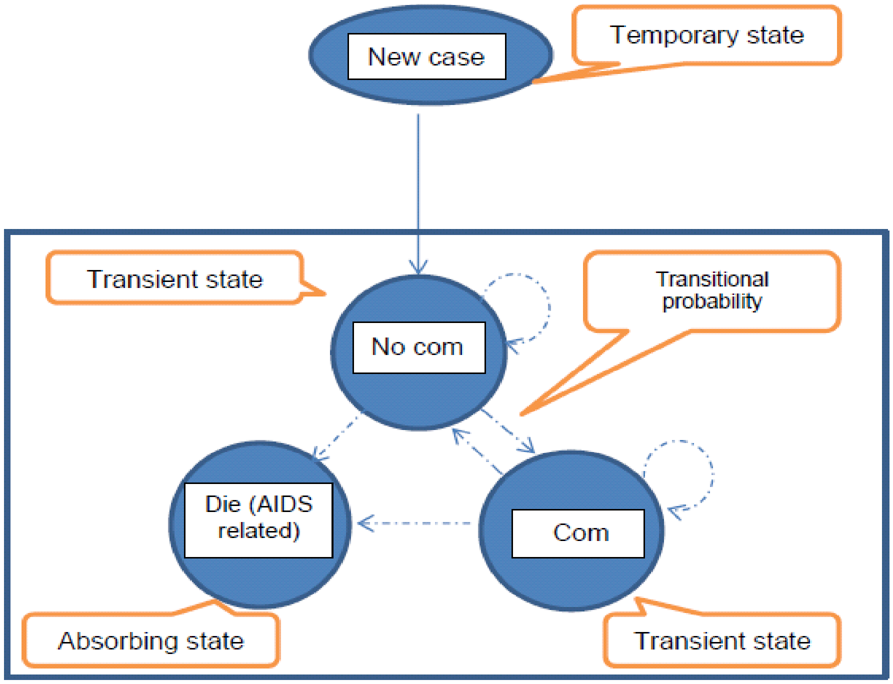
As a principle of the calculation, if I know future events with certainty, the decision making process is easy; I do not need a decision analysis. Conversely, if I have no information about the occurrence of future events, I would be unable to use decision analysis. My research problem is based on decision analysis, but in order to handle uncertainty in this study as a principle of the decision tree, at a point where several choices are possible: a point in a decision making process at which chance determines which outcome will occur, to reach a final outcome state. However, the outcome states of the ART service, as I have defined it, that could have occurred among the cohort of the ART service: following up without complication or with complication, are transitional. There are different probabilities for these different health states. The Markov model is therefore suitable for application for my analysis as a characteristic of ‘state-transitional models’ (Briggs et al. 2011; Health Intervention and Technology Assessment Program 2008; McPake et al. 2013). It could be applied for time motion study for many years in the future, as needed. This allowed me to apply the Markov model to project workforce requirements for the future.

I used Markov analysis to estimate and project the time required for healthcare providers to deliver ART services from 2012 to 2025. The Markov model, (figure 3.6) illustrates the mutually exclusive health states that a patient commencing ART might go through. The three health states which can develop after a PLHIV starts ARV drugs are follow-up with or without complications, with transitional probability, or death. The transitional probability is the likelihood of movement between each state. It is determined by using data from a retrospective cohort study in the sampling hospitals.

In this study, data was collected on a number of PLHIV following-up with or without complication, representing the entire number of PLHIV at the sampled hospitals, to calculate for transitional probability. I then used the transitional probability of PLHIV in each health state to run a Markov analysis, in order to calculate the time required for providing ART services, as a mean value, per state, and weighted according to the time that a PLHIV is expected to be in each state.

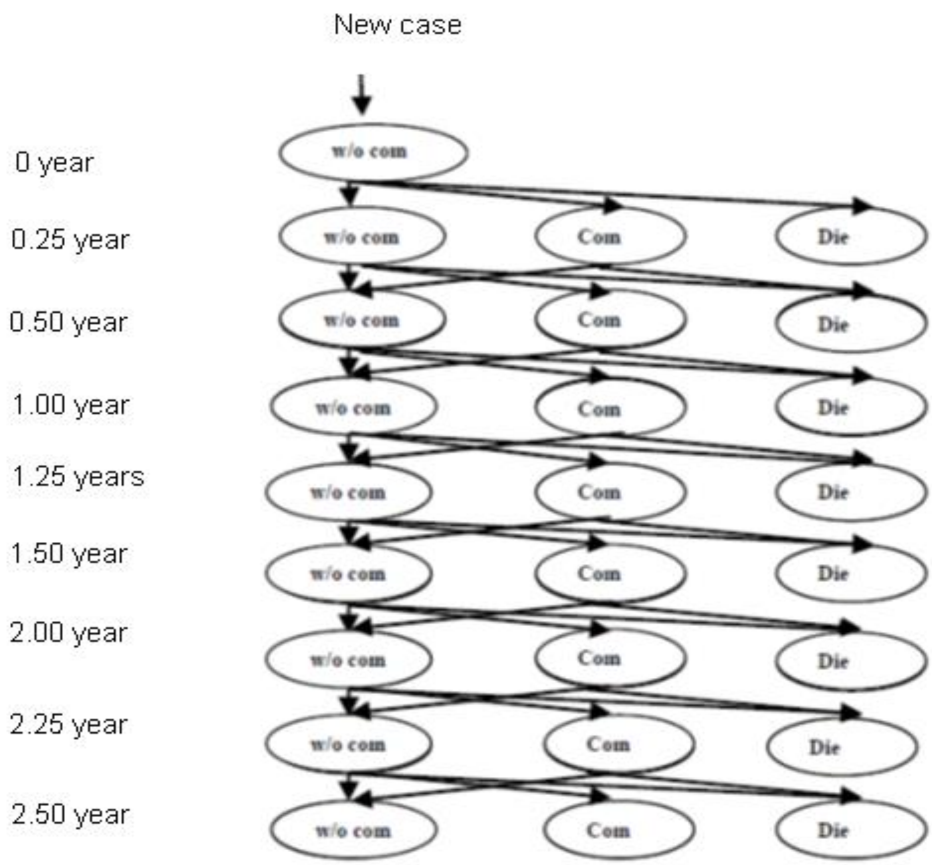
Probabilities of switching health state were calculated from primary data, separately for each three month period: Figure 3.6. A new case of PLHIV becomes a PLHIV following-up without complication after the first visit. Given that the majority of patients are still receiving care after one year on ART, the long-term effectiveness of ART, the rates of failure of first-line regimens, and costs and outcomes after treatment failure, are unknown for the foreseeable future. Estimates of the average probability of dying between baseline and one year were extrapolated from death transition probabilities. This probability was applied uniformly to all periods of treatment there after.

Figure 3.6 Conceptualised model of Markov analysis and transitional health states of PLHIV receiving ART services

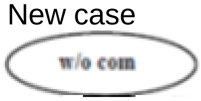


The health-state base of Markov states will be sub-divided into temporary states, known as tunnel states. During the first 3-month period, tunnel states will be created for each Markov cycle (Figure 3.7 below). A cycle length of one year for the full health states, and three or six or eight months for the sub-states, will be used for the analysis. The proportion of PLHIV entering the models among each health state has been based on the data of PLHIV in the HIV clinics in the sampled hospitals.

Figure 3.7 Schematic diagram of the Markov chain model for the three health states of PLHIV receiving ART services in each cycle (0.25 year as a quarter)



Note : New case represents PLHIV starts ART service



represents PLHIV followed up without complication ART service

represents PLHIV followed up with complication ART service

C. Formula and assumptions to run Markov model

1. First cycle: first visit

Cycle: 0

Age: 15

Probability:

1. State: No complication = 1

2. State: Complication = 0

Formula:

Probability of complication state at cycle 0

= Probability of complication of previous cycle +

probability of complication state of current cycle

= (Probability of no complication of previous cycle x probability of transitional state from no complication state to complication state) +

(Probability of complication state of previous cycle x (1 - probability of transitional state from

Complication to no complication - transitional state from complication to death related to HIV/AIDS))

Second cycle and further

1) Second cycle (1/12 = 0.083)

1. State: No complication =

Probability of no complication state at cycle of second year

= Probability of no complication remain to be no complication +

Probability of transitional state from complication to no complication of previous cycle

= (probability of no complication of previous cycle x (1- probability of transitional state from no complication to complication – probability of transitional state from complication to death related to HIV/AIDS) + (probability of transitional state from complication to no complication of previous cycle x probability of transitional state from complication to no complication of the current cycle)

2. State: complication =

(probability of no complication of previous cycle (year 0) x probability of transitional state from no complication to complication) + ((probability of complication of previous cycle (year 0)) x (1-probability of transitional state from complication to non complication – probability of transition state of complication to death related to HIV/AIDS))

2) A further cycle applied the same formula as the second cycle

D. Monte Carlo uncertainty analysis

A probabilistic sensitivity analysis, using a second-order Monte Carlo simulation, an analytical tool to assure the random selection of the input parameters, was carried out using Microsoft Office Excel 2010 (Microsoft Corp., Redmond, WA). All input parameters were assigned a probability distribution to reflect the feasible range of value, according to their respective probability distribution for each evaluation. This process was repeated 1,000 times to provide a range of possible values, given the specified probability distributions and utilisation rate, and was specified as triangular distributions, spanning the 95% confidence interval for each estimate, with the mode equal to the estimate in each instance.

The model was used to quantify the work-time of healthcare providers as the time required for providing ART services per PLHIV, including enrolment. The simulation was conducted to model the time required for providing ART services over a 99-year period, to cover the maximum total period over which the whole cohort could reasonably be expected to survive. An alternative model, to improve the standard of treatment following WHO recommendations, was conducted to simulate the time requirement for this model.

I applied all input parameters to the sensitivity analysis. The parameters were allotted a probability distribution to indicate the feasible range of value that each input parameter could reach. Alpha-, Beta- and Gamma- distribution were applied[21], and the simulation repeated, which drew one value from each distribution and calculated the time required

[21] Parameter distributions of mean and standard errors are also indicated as Gamma distribution, which can be any value from zero to infinity. The other two parameter distributions are Alpha and Beta. Alpha refers to an intervention or events of a health state that could occur. Beta distribution is a choice of probability bounded zero to one.

to provide ART services, to run a range of possible values to attain the specified probability distribution; the Markov model analysis could not provide the linear relationship between inputs and outputs. The results presented an average value from probabilistic sensitivity analysis.

3.4.2 Data interpretation

In the final interpretation of this study, the researcher reported the output as a lesson learned from these case studies, comparing the time required to deliver ART services as the full-time equivalence (FTE) between enrolment at a CD4 level of 350 cell/mm^3 or less (new guideline) and the currently implemented one, which recommends enrolment at a CD4 level of 200 cell/mm^3 or less; in each model of ART care and services in the sampled hospitals.

If the estimate suggests a FTE requirement higher than what was feasible or available in Thailand, the data collected from the data record form and observation were interpreted, providing supporting information for the use of an alternative adaptive model of ART services. This data interpretation process was very important because it was the link between the research and policy processes.

After interpreting the data from both quantitative and qualitative analysis, the information from my study will be an evidence base for developing improved HRP practices for ART services. The findings of the study will be transmitted to the National board Committee of ART services[22], which is the recognised process for feeding research into the policy process.

3.5 QUALITY ASSURANCE: VALIDITY, RELIABILITY AND REFLEXIVITY

An example of good practice in quality assurance is a transparency of methodology, identifying a clear analysis procedure, as presented in the research process in Sections 3.2, 3.3 and 3.4. To ensure quality inqualitative research, guaranteed validity, reliability and reflexivity are required.

The judgment of validity is supposed to present a logical test of statement (U.S. Government Accountability Office 1990; Yin 2014). Four criteria for judging the validity of research design are in common use for social science studies (Kidder and Judd 1991): these are construct validity; internal validity; external validity and reliability (Yin 2012; Yin 2014).

This study is designed to investigate how ART services are delivered, the time taken to deliver them, by which category of healthcare provider, at each level of provision, and within different models of care; and to project this data into a prediction of future needs and provision. To ensure quality assurance for my study, I used internal and external validity.

Internal validity, used to show how well this study was run, is mostly used in experimental and quasi-experimental research (Cook and Campbell 1979; Yin 2014). How did healthcare providers provided ART services in those setting? Why did they use

[22] The national board committee of ART service composed with multi-stakeholder of AIDS network; Department of Disease Control, National Health security office, Social Security Office, NGO, AIDS experts, experts of health system.

that model of care? This case study applied direct observation, which presents a strong case for internal validity, because the researcher has observed an activity, avoiding the possibility of inaccuracy likely in a verbal or written report of the activity. All questionnaires were rechecked by the researcher in any case of drop out. Statistical analysis was applied to assure data validity.

To increase validity of the collected data, the researcher triangulated the data from prior/other participants. Deviant data was deliberately investigated by asking for more detail and rechecking understanding between participant and researcher. Moreover, taking findings back to participants for their approval is a good way to ensure respondent validity.

For this mixed-method study, it was necessary to establish the validity of the scores from the quantitative measurement and to discuss the validity of the qualitative finding with the analytical generalisability. External validity defines the domain of this case study, from which the findings can be generalised to arrive at the same results, if the other study applied the same setting or group or sample of people of this study. External validity is suitable to assure the quality of this study. For a case study, analytical generalisability is directly suitable as a validity test of this study. External validity is part of the quality assurance of a study, which guarantees the reliability of its operations. Another study conducted by the same process, in a similar sample, would give similar results.

Another element which can ensure the quality of a study is reliability, which in quantitative research can demonstrate the operation of a study; for instance, it should be possible to repeat the process of data collection, using the same procedures, and achieve the same result (Yin 2012; Yin 2014). In qualitative research, reliability refers to accuracy of reporting and thoroughness of analysis (Green and Thorogood 2009). For this study, the data record form was the tool used as the framework to collect the data in structured interviews and by direct observation. This allows the repeatability of data analysis and interpretation, which will reflect the reliability of the data. A digital recorder was used to record conversation during the interviews; so the researcher can compare the written note with the records.

Reflexivity is another concern ensuring quality in qualitative research. Reflexivity is the process of reflecting on the effect of the researcher on data, generated as a participant in the field, and on the social or cultural process of the research (Green and Thorogood 2009). It also refers to the researcher’s awareness that they can influence the research processes, because they are often themselves influenced by their professional backgrounds and experiences (Mauthner and Doucet 2003). They may also have pre-conceived ideas, which will affect data interpretation. For this study, data collection was preceded by direct observation and structured interviews with healthcare and non-healthcare providers, using a data record form and open-ended interview questions. The ART team were not interupted during the provision of ART services during the field study, so the researcher’s reflexivity did not influence them. This shows that the methods of the study, especially those related to data collection, maintained appropriate quality standards.

Data was interpreted after collection and analysis, using the quantitive and qualitative approach as summarised in Figure 3.2 and Table 3.3. The estimated FTE requirement, resulting from interpretation of the data, is compared with the availability of healthcare workers, to give the gaps in the service. The data collected on the data record form, and by observation, was secondary data for the second stage, analysed systematically by mathemetical Markov and descriptive analysis, to elicit supporting information for anadaptive model of ART services. Reliability and validity were ensured as mentioned above. The validity of the interpretation is dependent on being able to demonstrate how these interpretations were reached (Section 3.4.2), following the process of data collection presented in Sections 3.3.1-3.3.4, and the data analysis in Section 3.4.1.

3.6 ETHICS

Ethical issues had to be considered because the study involved human interaction during the process of data collection (American Psychological Association 1982; Balnaves and Caputi 2001; Council of Europe 1990; David and Sutton 2011; May 2001). The collected data mostly involved healthcare providers from the ART service team at HIV clinics. The data collection process was anonymous, and did not include the names or personal details of participants. It was not necessary for the researcher to meet any PLHIVor collect any information from them during observation, and they were notobserved directly while they received ART services, but they were in the same location in which the providers were observed. Then the PLHIV would not be disclosured by the researcher and research procedure. There was no need to have PLHIV's identity in this research procedure. All the collected data, including that from secondary sources and structured questionnaires, was kept in a secure locker to which only the researcher had a key. This data security will be maintained for the foreseeable future.

All participants who were health providers were individually informed, both verbally and by being given an information sheet (Annex 3). They were given time to consider their participation, and gave their formal consent before the observation began: informed consent is therefore ensured (Annex 4). It was important that they understood that I recognized and respected their privacy, that it would be protected by the careful storage and use of any data collected, and that I guaranteed not to disclose any personal identifiers.

This study did not involve any potential for physical harm; there was no treatment or intervention. There was a need to protect participants from any consequent emotional or legal harm. The concept of informed consent makes it clear that the study will not impact on employment, or cause harm emotionally or legally. If participants felt harm of any kind, they had the right to terminate their involvement in the study after the researcher had explained the interview process as well as any related information that they had to have clearly explained before agreeing and signing the consent form. The participants were told that they could withdraw from the study at any time during or after data collection.

This study paid close attention to the anonymity and human rights of participants; healthcare and non-healthcare providers. In particular, the health status of PLHIV was kept private.This was a key ethical concern for a study dealing with the issue of HIV/AIDS. All data were collected and kept securely. In the secondary data, the clinical outcome of treatment (with complication or without complication) of PLHIV was referred by hospital number (H.N.) instead of by name. For this reason, consent forms for PLHIV were not required; they were not study participants, but were in the same areas as healthcare providers when data was being collected by direct observation; however, the data and information from PLHIV would not be able to disclosure for the names and faces of either providers or PLHIV to ensure confidentially and the ethical concerns.

3.7 CONCLUSION

In order to meet the objectives of the study as set out in Chapter 1, this chapter presents the multi-phase mixed-methodmethodological approach to an analytic descriptive-style case study. Both qualitative and quantitative approaches were applied during the processes of data collection, analysis and interpretation, to answer the research questions. Case study design was selected as most appropriate for this study. The six hospitals in three provinces with a high prevalence of HIV/AIDS were selected as study sites, which also aimed to represent all four facility levels of healthcare provision. 30% of the population was chosen as a suitable sample size to ensure a representative picture.

The process of data collection was in two stages. The first stage was to collect the variables of the activities, sequencing and organisation of the ART service on the sites, the time required to provide the ART service, and the frequency of ART clinic appointment for PLHIV. These data were the variables in the second stage of the study, the secondary data collection: the number of PLHIV and number of healthcare providers involved in ART services. The data from the second stage were used for the Markov and Monte Carlo analysis, the results of which provided an estimation/projection of thetime required to provide FTE of ART services. Moreover, requirements, workloads, gaps, and availability of healthcare providers, and quality of care, were analysed and interpreted in judging the choice between delivery models and raised specific recommendations. This chapter also presents the tool developed by this study by which HRH requirements can be estimated.

CHAPTER 4

FINDING: ART SERVICE ACTIVITY ANALYSIS

4.0 INTRODUCTION

This chapter presents the findings collected at the fieldwork stage of this study and analysedmainly in the qualitative approach. Sections 4.1 to 4.6 show the findings and analysis of data from Chiang Mai Province, Chonburi Regional Hospital and Prachuap Khirikhan Provincial Hospital.All three different models of care aredefined in this section. Three models were adapted to deliver ART service by applying HR strategies; task shifting, skill-mix and the participation of community health and non-healthcare workers, in their own localities.Section 4.7 presents a comparison of key aspects. Comparing the principal different aspects of the three models from the findings from this chapter, four main things distinguished them; task allocations, PLHIV characteristics, rate of loss to follow up of PLHIV, and the time required in minutes for providers to deliver ART services. The conclusion of this chapter is presented in Section 4.8. In Chiang Mai province, I observed healthcare providers delivering ART services to 308 cases of PLHIV. 307 of these cases were PLHIV receiving ART services at Sanpatong District Hospital and one case was from Ban Hourin Sub-district Hospital. This province represented the community based model of ART services. All sub-district hospitals could provide ART services for PLHIV who had a stable outcome of treatment (without complication). This model is called the “community-based model”, as the Sanpatong district hospital referred those PLHIV to the sub-district hospitals to let PLHIV receive ART in their own community.

At Chonburi Province, I observed provision of ART services to 984 PLHIV (31.03% of 3,171 cases). I spent four weeks in August and September, 2012 at Chonburi Regional Hospital collecting data, subsequent to receiving approval on 6th August, 2012.

Data was collected for 235 cases of PLHIV who were receiving ART services at Prachuap Khirikhan Provincial Hospital (35.13 % of 669 cases). Data was collected every Thursday for five weeks, in September and October, 2012 until the required sample size was achieved.

Table 4.1 Numbers observations at field sites from August to October, 2012

Selected hospitals	Total numbers of PLHIV receiving ARV drugs in the selected hospitals	Number of PLHIV observed in each hospital	
		Cases	(% of sample size to population)
I. Community-based model **II. : Sanpatong District in Chiang Mai Province (4 hospitals)**	924	308	33.33
1. Sanpatong District Hospital	893	307	34.38
2. Ban Hourin Sub-District Hospital	12	1	8.330
3. Ban Mae Kungluang Sub-District Hospital	10	0	-
4. Ban Rongngou Sub-District Hospital	9	-	-
II. Doctor-led model: Chonburi Regional Hospital in Chonburi Province	3,171	984	31.03
III. Mixed staff-worked model: Prachuap Khirikhan Provincial Hospital in Prachuap Khirikhan Province	669	235	35.13
Total 6 hospitals	**4,764**	**1,527**	**32.05**

4.1 SANPATONG DISTRICT HOSPITAL: COMMUNITY-BASED MODEL

4.1.1 Description of ART services

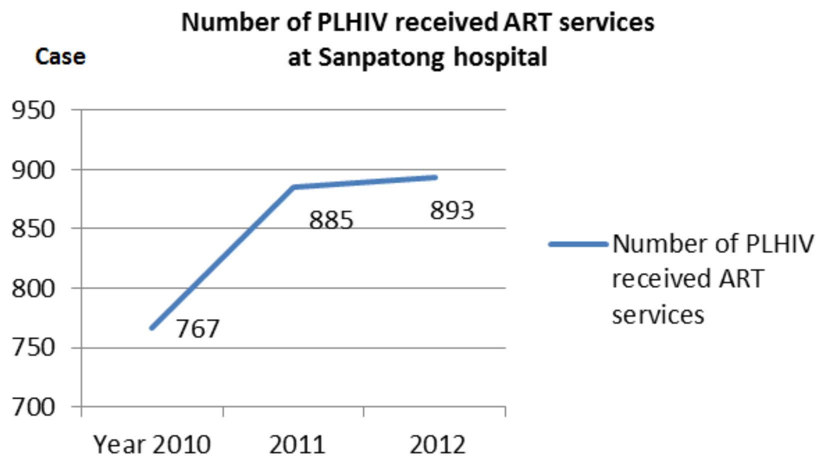
Sanpatong District Hospital represents the community level of care with 120 beds. This hospital had 405 healthcare providersfor apopulation of 76,610. The numbers of healthcare providers in Sanpatong District Hospital had remained stable since 2010. I used the data records to collect data and information about the number of healthcare providers, and the number of PLHIV from various aspects as shown in Annex 1.

At Sanpatong District Hospital, the ART service is a one-stop service model. ART healthcare providers deliver ART services at an HIV clinic. The service is open daily for seven hours a day, from 8.00 to 12.00 and from 13.00 to 16.00, five days a week. The ART team comprises one doctor, four nurses and one NGO volunteer who is a PLHIV herself; she supports the ART team and the pharmacy team in the pharmacy unit, which comprises two pharmacists and one pharmacist assistant, providing ARV drugs. In this team there was no counsellor with a graduate degree; however, one of the four nurses in the team, who was trained to provide counselling, takes responsibility for patients in the pre- and post-HIV test phase.

4.1.2 Data on PLHIV receiving ART service

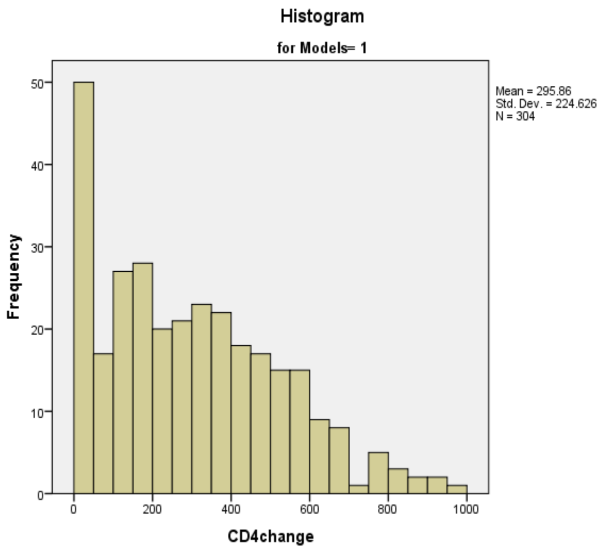
Focusing on the number of HIV/AIDS patients, there were about a thousand cases of PLHIV receiving ART services with an increasing trend every year since 2010. In 2012, there were 893 PLHIV receiving ART services, a significant increase from 2010, Figure 4.1.

Figure 4.1 Number of PLHIV receiving ART services at Sanpatong District Hospital, (2010 to 2012)



Data and information about Sanpatong District Hospital and ART services healthcare providers was collected using a data record form which shows the number of healthcare providers in the ART team by cadre, comparing this with the total number of healthcare providers of each specific cadre at the hospital. For instance, in 2012, the ART team at Sanpatong District Hospital had one doctor (5% of the total number of doctors), four nurses (2.4% of the total), two pharmacists and one pharmacist assistant (40% of the total) and four laboratory technicians (40% of the total), compared to the total of 20 doctors, 162 nurses, 10 pharmacists and 10 laboratory technicians (Table 1 in Annex 10). This comparison-ratio of the requirement and their availabilities could only generally present the field situation data. However, this ratio could not represent the actual ratio of the requirement and availability of healthcare providers to deliver ART service in the real practice as the results of this study.

Figure 4.2 Changes of CD4 count of PLHIV after receiving ART services at Sanpatong District Hospital in August 2012

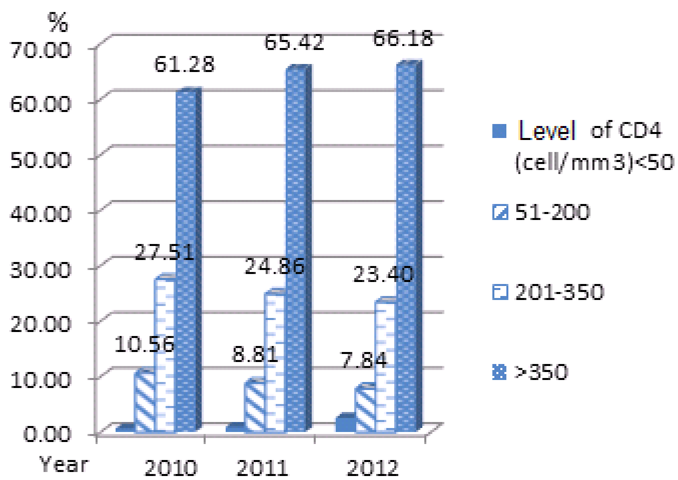


Source: ART clinic Sanpatong District Hospital 2012

PLHIV received ART service at Sanpatong hospitals for the first time when they had a low CD4 count. After they received ART, theyhada higher CD4 level (Figure 4.2). Figure 4.2 shows the differences in CD4 count of PLHIV before they received ART and their most recently recorded level in 2012. Most PLHIV had a higher CD4 level after receiving ART. On average, PLHIV had an increased CD4 count of about 300 cell/mm^3 after receiving ART.

Figure 4.3 categorises the ratios of PLHIV receiving ART services into four groups, according to CD4 count (cell/mm^3). The majority, over 60 percent of PLHIV receiving ART services, had a CD4 count of over 350 cell/mm^3 after they received ART. However, there were some PLHIV with lower CD4 counts, in the ranges of 201-350 (25%) and 51-200 cell/mm^3 (10%).

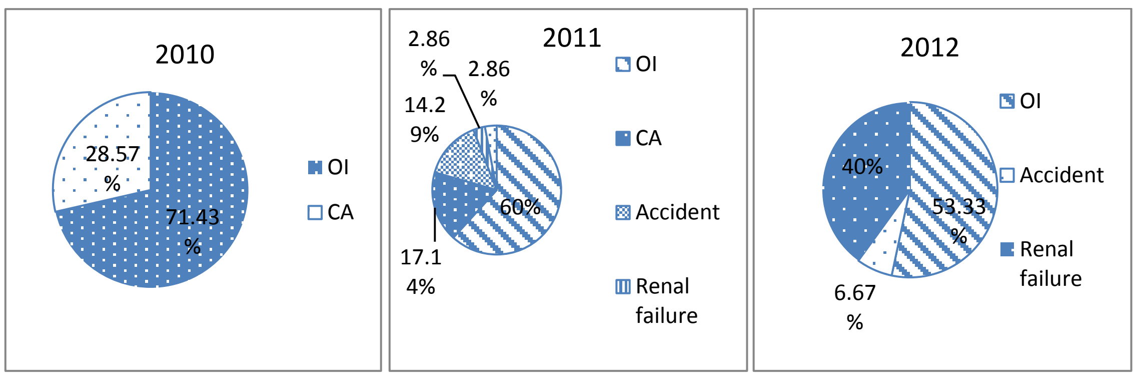
Figure 4.3 Ratio of number of PLHIV receiving ART services at Sanpatong Disctrict Hospital according to CD4 counts, (2010 to 2012)



Source: ART clinic Sanpatong District Hospital 2012

During the period when PLHIV were receiving ART services, several contracted opportunistic infections, cancer and renal problems. Most PLHIVs (71.43%) died from opportunistic infections (Figure 4.4). Seven PLHIV (0.91% of total) died in 2010. Five of them contracted opportunistic infections; of whom three (42.86%) were in the group having a CD4 count of 50 cell/mm^3 or less, and two had a CD4 count of 51-200 cell/mm^3 (28.57%).

Figure 4.4 Causes of death (%) of PLHIV (2010 to 2012)

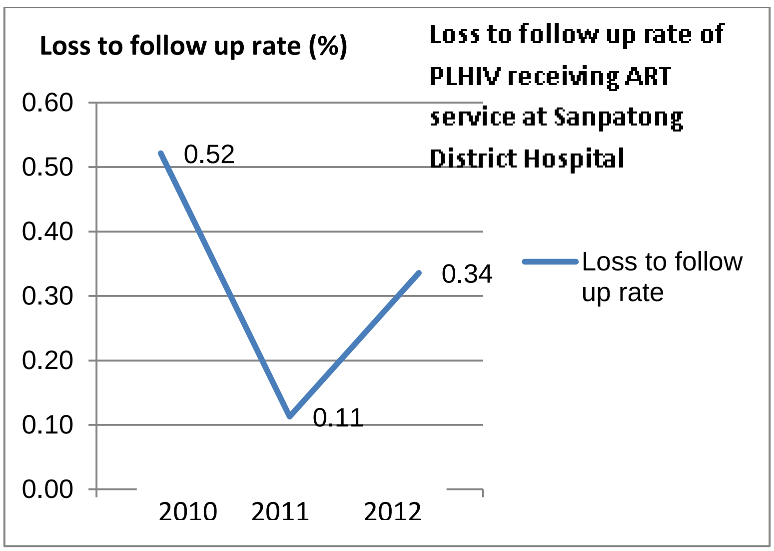


Source: ART clinic Sanpatong District Hospital 2012

Figure 4.4 shows that in 2011, PLHIV deaths totaled 35 (3.95% of total cases), which was higher than in 2010. Causes of death related to HIV/AIDS were from opportunistic infections (OI): (21 PLHIV), from cancer (CA): (6 PLHIV), accidents (5 PLHIV), and the other three from other causes. In 2012, 12 PLHIVs whose cause of death was identified as HIV had developed complications from adverse drugs reactions; 7.6% with acute and 35.8% with long term complications (Klinbuayam 2012). The number of deaths and the causes would be one parameter for Markov analysis in Chapter 5.

During 2010 to 2012, Sanpatong District Hospital had a loss to follow up rate in the range of 0.1 – 0.5% (Figure 4.5). The most common reason for loss to follow-up is the actual disappearance of the patient. The healthcare providers lost contact even though they sent NGOs and volunteer teams to patients' homes, butwere unable to find them. The ART team set the criterion of loss to follow- up when PLHIV had not met appointments and had lost connection with the hospital for more than three months.

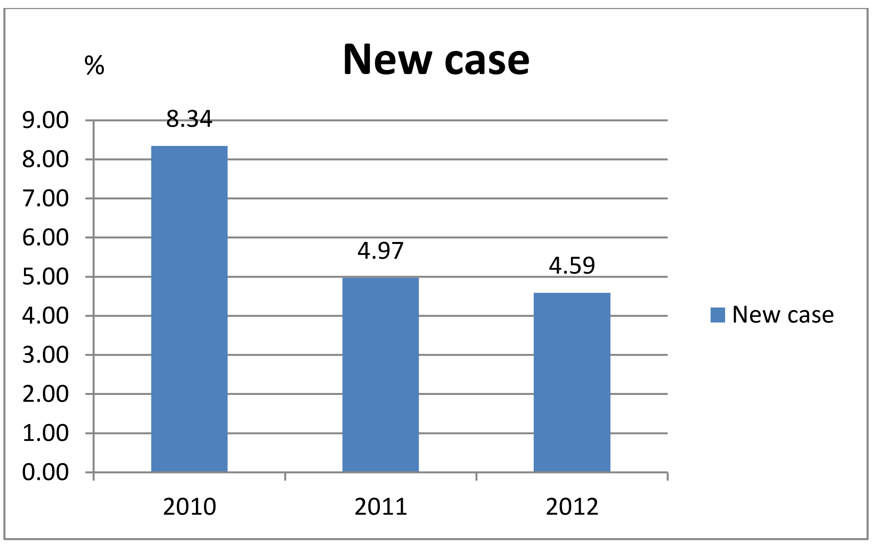
Figure 4.5 Loss to follow up rate of PLHIV receiving ART services at Sanpatong District Hospital, (2010 to2012)



Source: ART clinic Sanpatong District Hospital 2012

The ART team have sought help to obtain software which will flag up PLHIV who manifest loss to follow-up for more than three months (Klinbuayam 2012; Thakumta 2012). However, at the moment manual procedures are used, on a daily basis, to check PLHIV who have missed appointments. The day after a missed appointment, the ART team try to contact them by phone, and if no contact is made, ask the NGO volunteer (a PLHIV) to visit their homes to find out why they have not attended to check their health status and receive the necessary ARV drugs.

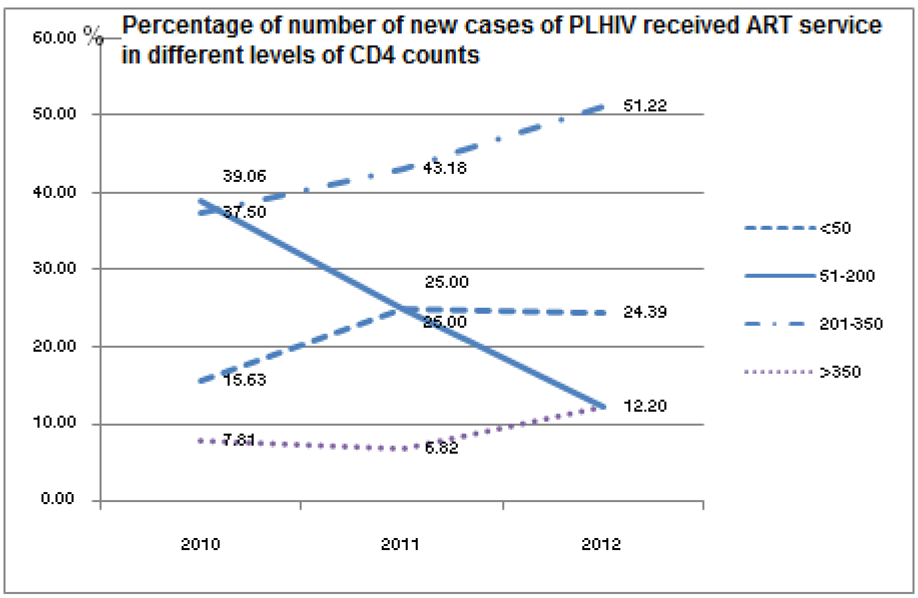
Figure 4.6 Percentage of new cases of PLHIV receiving ART service at Sanpatong District Hospital, (2010 to 2012)



Source: ART clinic Sanpatong District Hospital 2012

In 2010, 8.34 % of total PLHIV were new cases receiving ART service. Two years later, new cases receiving ART service had decreased (Figure 4.6). Most of new case started ART services as late recruitment when they CD4 count lesser than 200 cell/mm^3; in 2010, over 50% of new cases of PLHIV accessed the service when they had a CD4 count lower than 200 cell/mm^3.

Figure 4.7 Percentage of number of new cases of PLHIV receiving ART service at Sanpatong District Hospital, according to level of CD4 count (2010 to 2012)



Source: ART clinic Sanpatong District Hospital 2012

However, there was a decreasing trend of new case PLHIV having CD4 levels of 51-200 cell/mm^3 (Figure 4.7). PLHIV when recruited late to the ART service often had complications, since they had very low CD4 counts. Some of them came to the clinic with OIs (Thai Working Group on HIV/AIDS 2008).

By contrast, there was an increase in the number of new cases with CD4 counts at higher levels, where as numbers with low CD4 counts accessing ART decreased in the following year. PLHIV accessing ART services when they still had high CD4 levels may relate to several factors; for instance, the UC policy that allows hospitals to enrol PLHIV who had CD4 count under 350 cell/mm^3 (changed from CD4 count under 250 cell/mm^3 in 2012).

4.1.3 Task allocation and flow of ART services

Open-ended interviewswere conducted to investigate the flow or sequence of ART services. The head of each cadre of healthcare providers was interviewed. Data and information from the interviewsindicated the flow, as presented in Figure 4.8. Quotes from the interviews are given to highlight some of the data.

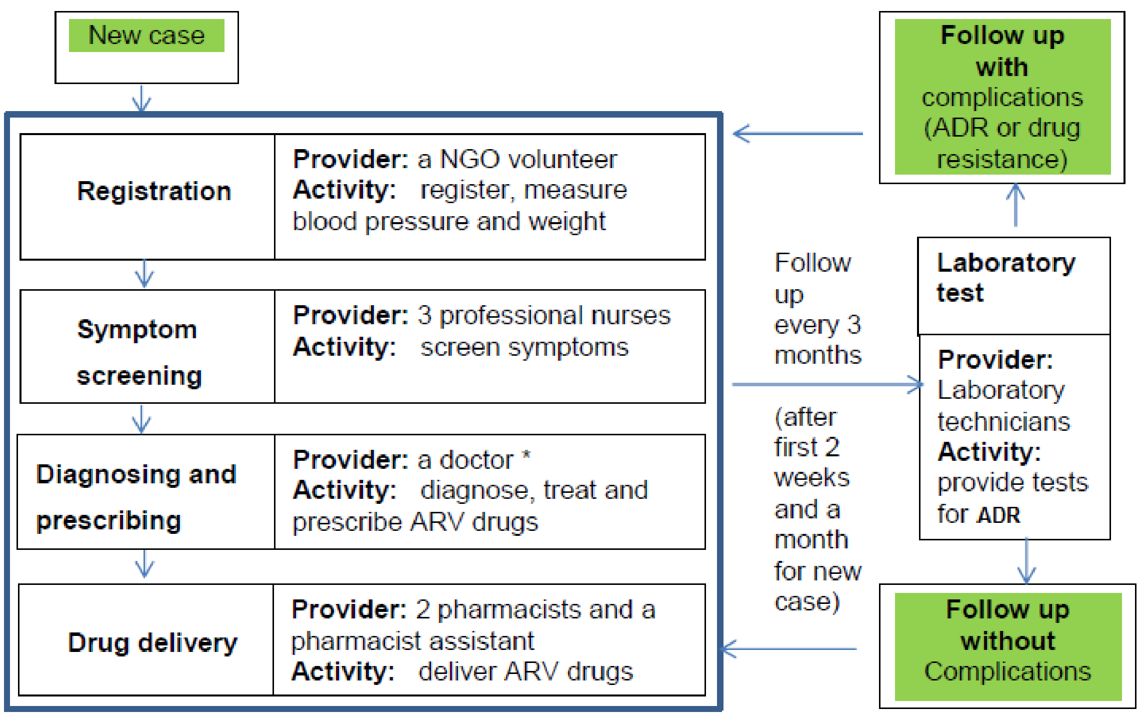
"New cases of PLHIV were given an appointment in two weeks time and another in one month, for following up the results of laboratory testing and for dispensing more ARV drugs" (Head of nurse-team of ART clinic).

"For PLHIV with complications (acute adverse drug reactions (ADR)), adjustments were made to the dosage of ARV drugs, or changes were made to their regimens. However, if they had complications (resistance to ARV drugs), they needed to wait for the team of consultants who are ART experts, and are able to consider the situation and authorise the doctor at Sanpatong District Hospital to change to a second-line regimen" (Head of ART clinic).

“PLHIV who had an appointment to have laboratory testing were asked to have the tests in the early morning before meeting the doctor or nurse” (Head of Laboratory technician).

A new case of PLHIV accessed the service flow, receiving ART services from the registry desk until the end of the process: receiving ARV drugs from a pharmacist. If the patient has no complications of treatment, they will get an appointment every 3 months to see the team of nurses (instead of a doctor) to receive ART services as a one-stop service (Figure 4.8).

Figure 4.8 Flow of ART services of Sanpatong District Hospital



Note: ADR refers to adverse drug reaction

4.1.4 Analysis of task allocation and competencies for ART services at Sanpatong District Hospital

The data record form part 2 was used to collect data for analysing task allocations for ART services at Sanpatong District Hospital. This information was obtained through an interview with the head of the ART clinic, as well as observing the actual ART services themselves. Annex 1 (data record form part 2) shows checklists of activities and the task allocations of the ART team. The results of task allocations of Sanpatong District Hospital were presented in data record form in Annex 10.

4.1.4.1 Registration

PLHIV who had appointments registered directly at the registry desk of the ART clinic. Healthcare providers from the team at the ART clinic trained the NGO volunteer working in the ART team in the task of providing ART services to PLHIV at the registry point; this then became her responsibility. The ART services at this point consisted of registration, followed by weight and blood pressure measurement, and took place from 8.00 a.m. until 9.00 a.m. However, PLHIV who arrived late were still registered and had their weight and blood pressure measured until 12.00 p.m. After 12.00 p.m., anyone arriving at the clinic would be registered and measured by the healthcare provider, not the NGO volunteer. Normally, anyone who came later than 12.00 would not be accepted, but the healthcare provider would consider and decide on a case-by-case basis. I entered the date and attached the daily record form to the OPD card of each PLHIV at the registry desk, and recorded the time registration started and finished. The card would remain attached to the OPD card and proceed to the next service. The healthcare providers in each unit entered the time the services started and stopped on the form.

4.1.4.2 Symptom screening

The symptom screening activity was provided by two professional nurses (nurses 1 and 2). They screened the symptoms of the PLHIV who were attending follow-up appointments for ADR clinical problemssuch as jaundice, insomnia, or any other symptom even it does not relate to the ART. After symptom screening adherence to ARV drugs was checked. After this the PLHIV walked to another desk beside the desks of nurses 1 and 2 in order to get a repeat prescription for drugs with nurse 3.

4.1.4.3 Diagnosing and prescribing

The processes of diagnosis and prescription were provided by one medical doctor having over 20 years experience of being responsible for treating PLHIV. The doctor updated his HIV/AIDS and ART knowledge by attending conferences, seminars and meetings, both locally and globally, at least once a year. The doctor assigned three professional nurses in the ART team, who have long- term experience in providing ART services over 10 years of the doctor’s ART team, to prescribe ARV drugs for PLHIV who have stable responses to treatment. However, these patients could, if requested by nurses, receive diagnosis and prescription from the doctor in a separate private room. Other PLHIV who had to see the doctor were those with a complicated response to treatment, such as short or long term adverse reactions to ARV drugs, drug resistance or OIs. These decisions are made by doctor for PLHIV referred to him by nurses due to symptoms, complications from ARV drugs, or opportunistic infections.

4.1.4.4 Drug dispensing

After the process of prescription by doctor or nurse 3, PLHIV would walk through the treatment unit to the separate pharmacy unit to hand in their prescriptions and collected their ARV drugs from the pharmacy team, comprising two pharmacists and one pharmacy technician. The pharmacist read and checks the prescription before passing it through to the assistant who would prepare the ARV drugs. During this process, if the pharmacist had any queries about drug regimens that doctor prescribed or drug, interactions, they could take the prescription back to consult the doctor or nurse who prescribed the drugs ensuring that the prescription is correct. After the first pharmacist have checked and passed the prescription to the pharmacy technician, he or she prepares the drugs and passes them to the second pharmacist to double check them and give them to the PLHIV with necessary explanations for their use.

4.1.4.5 Counselling for new cases of ART

This service is delivered by a professional nurse trained in ART counselling. One of the three nurses would leave her task of screening, diagnosis and prescribing ARV drugs to provide counselling to pre- and post-HIV test patients in the room opposite to the screening desk for only new cases of ART. The counselling session took about 45 minutes. This would provide some impact on the work flow to the ART service; however, this would not be significant because new cases do not access the clinic very often each day (4.5% of total case/year in 2012). I observed only one case of a new patient receiving ARV counselling after having an HIV test and before receiving ARV drugs; for this reason the time taken cannot be considered as representative.

4.1.4.6 Laboratory testing

This service is delivered by a team of laboratory technicians at the laboratory in the central unit of the hospital. PLHIV with an appointment for laboratory testing are asked to have blood testing (chemistry, liver and kidney function tests, hematology, etc.) in the early morning before meeting the doctor or nurse. Some PLHIV are asked to have laboratory testing after meeting the doctor; however, the laboratory team can report the results of tests to the doctor and PLHIV within half an hour on the same day, such as the liver and kidney fuction tests and haematology. However, for CD4 level and viral load testing, the laboratory takes between one to two weeks, because they arrange their schedules for these tests only once a week; they take over an hour each.

4.1.5 Time required to provide ART services at Sanpatong District Hospital

The descriptive analysis of comparisons of the time required to provide the three elements of ART services (registration, diagnosis and drug dispensing) were analysed with the SPSS statistical analysis (Annex 11). As far as the other activities, including laboratory testing and HIV/AIDS counselling, are concerned, I did not have the opportunity to observe them; for this reason I did not include the time required for them in the analysis.

Data of the time taken to provide elements of ART services were tested for normal distribution. The time required to provide the elements of ART services is not a normal distribution. The statistical analysis set is applied with a non-parametric test and with an independent sample test. Means of time required to provide each activity of ART services are presented in Table 4.2.

Table 4.2 Comparisons of time required to provide ART services to the three different groups of PLHIV (by status of treatment outcome), Sanpatong District Hospital, August, 2012

Groups of PLHIV categories by treatment outcome	Time required to provide ART services by activities in minutes (mean + SE**)			
	Registration	Symptom screening and diagnosis *	Drug delivery	Total *
Normal (271 cases, 88.27%)	1.86 + 0.41	3.84 + 0.11	2.54 + 0.15	8.24 + 0.18
Complications (33 cases, 10.75%)	1.82 + 0. 01	5.79 + 0.49	2.62 + 0.46	10.23 + 0.60
New cases (3 cases, 0.98%)	2.00 + 1.00	6.00 + 1.00	1.77 + 0.11	9.78+ 2.11
Average of time required for healthcare providers to deliver ART services (307 cases)				**8.47 + 3.08**

Note * refers to the significant difference among three different groups by treatment outcome of PLHIV (normal, with complications or new cases) at P-Value <0.05

** SE refers standard errorwhich is an estimate of that standard deviation, computed from the sample of data being analysed at the time. It is the standard deviation of those sample means over all possible samples (of a given size) drawn from the population

The results of mean comparison of time required to provide each element of ART services show that means of total time required to provide ART service are different significantly.Providers delivered ART services for PLHIV who followed up with complications with highest time, followed by the group of new cases and PLHIV followed up with out complications, respectively.

Screening and diagnosis elements show significant difference of mean compared between the three different treatment statuses. However, the mean of time required to provide ART to the group following up with complications, and the group of new cases, is not different, whereas the time spent on the group of PLHIV following up without complications is significantly less than that of the other two groups (P-value $\leq$ 0.05). On the other hand, there is no difference in mean comparisons in the elements of registration and drug delivery.

Sub-district hospitals

In Sanpatong District Hospital, there has been a transfer of PLHIV with a stable ART outcome status to 18 Sub-District Hospitals in Sanpatong community (District). Sanpatong ART team had prepared the community to accept their PLHIV living in those sub-districts since 1994, as well as preparing, monitoring and networking systems to support the Sub-District Hospitals supported by Sanpatong hospital. It took about ten years for the preparation and pilot study, and transfer of PLHIV started in 2004. In 2012, 105 PLHIV transferred to follow-up at 18 Sub-District hospitals. PLHIV were followed up for clinical status and immunology: CD4 levels and viral load every 6 months. If they had a stable clinical outcome, increasing levels of CD4 and a compressed viral load, they were considered for transferring to receive ART at the sub-district hospitals in the community (Thakumta 2012).

In each sub-district hospital in Sanpatong district, there were usually three main healthcare providers in the sub-district hospital: nurses, nurse assistants and community health care worker.

“Patients are given three months’ supply of drugs at Sanpatong District Hospital; healthcare providers at the sub-district hospitals are provided with enough of the same drugs to dispense them to patients monthly” (Head of Pharmacy unit).

The health care providers at the sub-district hospitals sent the PLHIV to follow-up by having laboratory tests and updating their knowledge of ART management as well as information about HIV and ARV at the Sanpatong District Hospital every six months.

Table 4.3 shows the 18 sub-district hospitals as the network of the Sanpatong District Hospital, which acts as the centre of the Sanpatong community ART service network. Since PLHIV began to be referred to the sub-district hospitals in 2004, eight (7%) of 113 PLHIV left treatment. Five of the eight were dead. Another one decided to receive ARV drugs from a research programme (Thakumta 2012). Of the remaining two, one moved to live in another place and the last one disappeared. This indicated that the loss to follow-up figure for ART services at the 18 Sub-district hospitals was only one among 113 cases (0.88%).

Table 4.3 18 sub-district hospitals providing ART to PLHIV (followed up without complications), August, 2012

No.	Name of sub-district hospital	Number of PLHIV when Sanpatong Hospital transferred them to sub-district hospitals	Number of PLHIV at sub-district hospitals lost from ART services	Number of PLHIV receiving ART services
1	Kew Laeluang	3	0	3
2	Kew Laenoi	4	0	4
3	Dong Kum	7	1 (dead), 1 (research)	5
4	Sai Moon	4	1 (dead), 1 (disappear)	2
5	Tha Pong	6	0	6
6	ToongSeaw	7	1 (dead)	6
7	Toong Look	6	0	6
8	NumBorluang	2	0	2
9	Ban Pieng	3	0	3
10	MakhamLuang	12	1 (dead)	11
11	MakhunWhan	13	1 (dead)	12
12	Mae Kungluang	10	0	10
13	Ban Rongngou	9	0	9
14	Ban Hourin	13	1 (left a village)	12
15	Tong Tom	1	0	1
16	San Hoa	3	0	3
17	Nong Ha	5	0	5
18	HuaySom	5	0	5
Total		**113**	**8 (7%)**	**105 (93%)**

4.2 BAN HOURIN SUB-DISTRICT HOSPITAL

Ban Hourin Sub-District Hospital represents the type of healthcare at sub-district level, which is very close to people in villages. The sub-district hospital has only one bed for patients, but they are not allowed to stay overnight as in-patients, as this service is available at other hospitals which have higher levels of care. Three healthcare providers; nurse and two community healthcare workers, are paid by the Thai government for working and providing all the health services there. The data record form was used to collect data and information about the number of healthcare providers and number of PLHIV from a variety of aspects, as shown in Annex 12.

Table 4.4 Time table of healthcare activities at Ban Hourin Sub-District Hospital, August, 2012

Day	**Time**			**Over time**
	8.30 – 12.00	**12.00 – 13.00**	**13.00 – 16.30**	**16.30 –18.30**
Monday	General	Lunch	Home visit	
Tuesday	Diabetes Mellitus		Home visit	
Wednesday	Mother and child health		Home visit	
Thursday	Family Planning		Home visit	
Friday	Hypertension		Home visit	
Saturday	Over time			
Sunday	Over time			

Table 4.4 illustrates the activity during one typical week at Ban Hourin Sub-District Hospital. For example, on Monday morning, the hospital decides on the general medical activities for the morning; in the afternoon, they move out to the villages for home visits. On Tuesday, the healthcare providers run a clinic for Diabetes Mellitus in the morning and make home visits in the afternoon as before. On Wednesday, Thursday and Friday mornings, they run mother and child, family planning and

hypertension clinics. They did not have a specific schedule for ART services. This means that PLHIV can make an appointment to see the nurse at the sub-district hospital whenever is convenient for them, and these appointments usually take place nearly every day of the week. Healthcare providers integrate ART services; following up PLHIV when they provided home visits.

4.2.1 Analysis of task allocation of ART services at Ban Hourin Sub-District Hospital

From an interview with a nurse at Ban Hourin Sub-District Hospital who is responsible for ART services (Benjakullaya 2012), the healthcare providers worked seven hours a day and five days a week from 08.30 a.m. to 12.00 p.m., and from 1.00 p.m. to 4.30 p.m. Two community healthcare workers and one nurse provided ART services. The nurse provided most of the ART services, including measurement, weighing and blood pressure checks, symptom screening and evaluating effective adherence to the ARV drugs. The nurses working at the sub-district hospitals were trained about ART service by the doctor and nurse at Sanpatong District Hospital before provider ART service for their PLHIV.

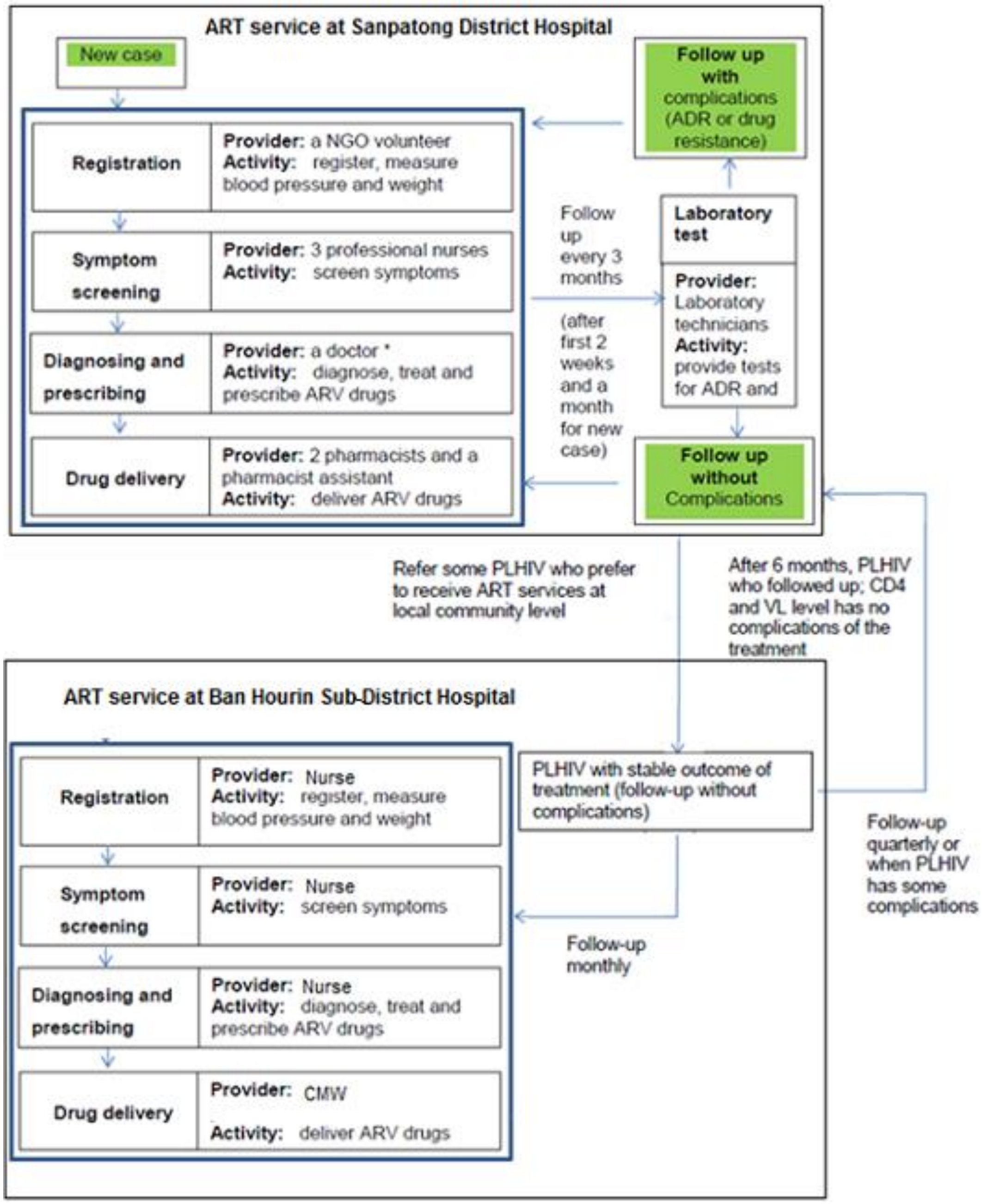
There were many services that the sub-district hospital did not provide to PLHIV, for example, clinical monitoring. PLHIV would receive clinical monitoring every three months at the Sanpatong District Hospital. “There is a collaboration between district hospital and sub-district hospital providing ART services to PLHIV at the local level, as a primary care unit” (Head of ART clinic of Sanpatong District Hospital). The sub-district hospital did not provide group counselling, clinical monitoring and laboratory testing to PLHIV at the time they were being treated.

PLHIV visited the hospital every month to obtain further supplies of ARV drugs and receive health and symptom screening. PLHIV kept a three-months supply of ARV drugs for any PLHIV registered with them. When this supply has almost run out, the nurse will make an appointment for those PLHIV to visit the Sanpatong District Hospital in order to obtain a further supply of the drugs, the checking of clinical outcome, and laboratory tests for monitoring any adverse drug reactions and screening for drug resistance.

4.2.2 Flow of ART services at Ban Hourin sub-district hospital

PLHIV who had stable clinical outcomes to ART were referred on to receive ART services at the sub-district hospital which was close to their village (Figure 4.9). When PLHIV arrived at the sub-district hospital, they were measured, weighed and had their blood pressure taken by a nurse. Then the nurse screened their symptoms and evaluated their adherence to ARV drugs. They continued to be prescribed the same ARV drugs and regimen, since there were no complications, such as adverse reaction to the drugs or drug resistance.

Figure 4.9 Flow of ART services at Ban Hourin Sub-District Hospital and linkage of ART service to Sanpatong District Hospital



Note: VL refers to viral load

CHW refers to community healthcare worker

PLHIV who have been referred on to receive ART services at the sub-district hospital still had to follow-up at Sanpatong District Hospital every three months in the same way as those who were receiving all their ART services at there. It seems that the hospital still retains overall control of ART services offered to PLHIV.

During the time when PLHIV were receiving ART services, they all had a stable clinical outcome to their treatment. They had higher CD4 levels every year, from very low levels when they started ARV drugs. In 2010, there was one PLHIV with a CD4 count in the range of 51–100 cell/mm^3, but in 2011, there were none. By 2012, six PLHIV (50%) had a count higher than 350 cell/mm^3; four (33%) had a count in the range of 201-350 cell/mm^3; the other two (0.17%), had a count higher than 100 cell/mm^3. This can be taken as a mark of the effectiveness of ARV treatment.

Table 4.5 Number of PLHIV by levels of CD4 count, Ban Hourin Sub-District Hospital (2010 to 2012)

CD4 count (cell/mm^3)	Number of patients Loss to follow-up				
	On ART			Death	Loss to follow-up
	2010	2011	2012	2010 to 2012	2010 to 2012
<50	0	0	0	0	0
51-100	1	0	0	0	0
101-200	3	3	2	0	0
201-350	2	2	4	0	0
>350	6	7	6	0	0
Total	12	12	12	0	0

Table 4.5 shows the number of PLHIV and their different CD4 counts between 2010 and 2012. The table shows that no PLHIV died or were lost to follow-up. This means that PLHIV who received ART services at Ban Hourin Sub-District Hospital had good clinical outcomes to treatment in relation to the rising trends of CD4 count of PLHIV

over 3 years and that the ART services at Ban Hourin Sub-District Hospital performed effectively.

4.2.3 The time required to provide ART service at Ban Hourin Sub-district Hospital

I had only one opportunity to observe a PLHIV receiving ART service at Ban Hourin Sub-District Hospital. The nurse spent five minutes for all ART activities, starting with measuring blood pressure and weight, then screening symptoms and diagnosing any health problems and finally dispensing another month’s worth of ARV drugs. The nurse also noted the date that the ARV drugs would run out, which then indicated when that PLHIV needed to return to receive a further supply. However, the nurse asked the patient to return at any time if they had any unexpected symptoms whilst they were taking the drugs. From the statistical aspect, one case cannot be considered representative significantly of the time required to provide ART services at the sub-district level.

4.3 BAN MAE- KUNGLUANG SUB-DISTRICT HOSPITAL

Ban Mae-Kungluang Sub-District hospital also represents sub-district level of healthcare cover 3,898 populations in this sub-district. This hospital has a similar structure to other buildings in the village, and similar human resources to the other sub-district hospitals. It has one bed to be used for screening and diagnosing patients for general symptoms and performing first aid. Patients cannot stay overnight, i.e. there are no in-patients. I used the data record form to collect data and information about the number of healthcare providers and PLHIV, from a variety of aspects, as shown in Table 1 in Annex 13. At Ban Mae-Kungluang Sub-District Hospital, the three healthcare providers are paid by the Thai government in a similar way to those at Ban Hourin Sub-District Hospital.

4.3.1 Analysis of task allocations for ART services at Ban Mae-Kunluang Sub-District Hospital

From an interview with a professional nurse at Ban Mae-Kungluang Sub-District Hospital, responsible for ART services (Sithisak 2012), I found a similar timetable of healthcare providers working seven hours a day, as at Ban Hourin Sub-District Hospital (Table 4.5); the organisation of healthcare providers, in types, numbers, activities and roles in providing ART services were also similar. There were two community healthcare healthcare workers and one nurse providing ART services; there was no doctor, pharmacist, and laboratory technician orcounsellor. Nurses were the main providers of ART services, including measurement, weighing and taking of blood pressure, symptom screening and the evaluation of adherence to the ARV drug regimen.

Focusing on quality of care by considering the CD4 count of PLHIV who received ART services at Ban Mae-Kungluang Sub-District Hospital; PLHIV had a stable clinical outcome to treatment. They had higher CD4 levels every year, starting from very low levels in the year that they began taking ARV drugs. In 2010, there was one PLHIV (0.10% of the total) with a CD4 count in the range 51–100 cell/mm^3; in 2011, there were none in this range. By 2012, six PLHIV (60%) had a CD4 count higher than 350 cell/mm^3, one. Each of two PLHIV (20%) had a CD4 count in the range of 101-200 and 201 -350 cell/mm^3, respectively. This can be taken as an indicator of the effectiveness of ARV treatment.

Table 4.6 shows the number of PLHIV by the levels of CD4 count, between 2010 and 2012, which no PLHIV died and that none were lost to follow-up. They had a good clinical outcome from the treatment, and therefore, the ART service of Ban-Mae Kungluang Sub-District Hospital appears to perform effectively.

Table 4.6 Number of PLHIV by levels of CD4 count, Ban Mae-Kungluang Sub-District Hospital (2010 to 2012)

CD4 count (cell/mm^3)	Number of patients Loss to follow-up				
	On ART			Death	Loss to follow-up
	2010	2011	2012	2010 to 2012	2010 to 2012
<50	0	0	0	0	0
51-100	1	0	0	0	0
101-200	2	3	2	0	0
201-350	1	3	2	0	0
>350	6	4	6	0	0
Total	10	10	10	0	0

4.3.2 Flow of ART services at Ban Mae-Kungluang Sub-District Hospital

I had no opportunity to meet PLHIV, in order to observe healthcare providers delivering ART services at Ban Mae-Kunglung Sub-District Hospital because there were no appointments during my fieldwork study. They offered to ask PLHIV to attend the hospital, in order to demonstrate how they delivered ART services, but this would not have been an authentic observation: a demonstration which would have given different results. However, I interviewed the nurse about the flow of ART services.

4.4 BAN RONGNGOU SUB-DISTRICT HOSPITAL

Ban Rongngou Sub-District Hospital also represents the level of healthcare facilities at the sub-district level, close to people living in villages. The building has a similar structure to the sub-district hospitals in Ban Hourin and Ban Mae-Kungluang, and a similar organisation of human resources for the provision of ART services. Data and information I collected concerning Ban Rongngou Sub-District Hospital is presented in Annex 14.

4.4.1 Analysis of task allocations for ART services at Ban Rongngou Sub-District Hospital

From an interview with a director of Ban Rongngou Sub-District Hospital (Somrin 2012), a senior community health care worker, I found that they operate the same time table, activities and roles of healthcare providers as the other two sub-district hospitals presented.

Focusing on quality of care by considering CD4 count of PLHIV who received ART services at Ban Rongngou Sub-District Hospital, PLHIV have stable clinical outcome to treatment. They had a higher CD4 level every year, starting from a very low level in the year they began taking ARV drugs.

In 2010, one PLHIV (0.11%) had a CD4 count in the range of 51-100cell/mm^3; in 2011, there were none. In 2012, one (0.22%) had a CD4 count in the range of 101-201cell/mm^3, another had a CD4 count in the range of 201 to 350 cell/mm^3. The remaining seven (78%) had a CD4 counts higher than 350 cell/mm^3. This can be a good marker of the effectiveness of ARV treatment.

Table 4.7 shows the number of PLHIV by the levels of CD4 count, between 2010 and 2012. It also demonstrates that no PLHIV died or were lost to follow-up. This means that PLHIV who have been receiving ART services at Ban Rongngou Sub-District Hospital had a good treatment outcome.

Table 4.7 Numbers of PLHIV by levels of CD4 count, Ban Rongngou Sub-District Hospital (2010 to 2012)

CD4 count (cell/mm^3)	Number of patients Loss to follow-up				
	On ART			Death	Loss to follow-up
	2010	2011	2012	2010 to 2012	2010 to 2012
<50	0	0	0	0	0
51-100	1	0	0	0	0
101-200	0	1	1	0	0
201-350	2	1	1	0	0
>350	6	7	7	0	0
Total	9	9	9	0	0

4.4.2 Flow of ART services at Ban Rongngou Sub-District Hospital

I had no opportunity to meet PLHIV to observe the provision of ART services at Ban Rongngou Sub-District hospital, because they had no appointments with PLHIV during my fieldwork study. However, they routinely made home visits, integrated into other healthcare activities. The ART services at Ban Rongngou consisted almost entirely of home visits. Healthcare providers did not refill ARV drugs for PLHIV every month as was done in Ban Hourin and Ban Mae-Kunglunag Sub-District Hospitals. The healthcare providers allowed PLHIV to have three months' worth of ARV drugs. The healthcare provider carried out home visiting to follow up compliance to the drugs regimen.

Sanpatong District Hospital adapted the ART model by applying a task-shifting HR strategy. Doctors shifted the task of diagnosis and drug prescribing, for PLHIV following up without complications, to nurses. Moreover, Sanpatong District hospital delegated tasks of ART service for PLHIV who had stable clinical outcomes of treatment; following up with out complication, to be followed at the sub district hospitals in the Sanpatong district. This community-based model as presented responded to the decentralised and UC policy. The Sanpatong District Hospitals still acted as the main hospitals for the sub-district hospitals to consult, and sentall PLHIV following up from the sub-district hospitals back to the Sanpatong District Hospital to have laboratory tests in every 6 months. This model reduced the workload of doctor and nurse at the district hospitals and benefitted the travelling costs and time for PLHIV who were followed up at their homes. Numbers however are low even in an area of high HIV prevalence.

4.5 CHONBURI REGIONAL HOSPITAL: DOCTOR-LED MODEL

4.5.1 Description of the services

Chonburi Regional Hospital represents a regional level of health care, with 825 beds, and covers 1,134,011 people for the healthcare services of the province. This hospital provides healthcare services at a tertiary level, as do the other 25 regional hospitals across the country (Ministry of Public Health 2008). Chonburi Regional Hospital would receive patients referred from other provinces in the region. Then the size of population that the Chonburi Regional Hospital covers would be larger than the population in the province. Chonburi Regional Hospital is a teaching centre for medical doctors and nurses. The hospital is the referral centre for many hospitals in the eastern region of Thailand. It provides a wide range of healthcare services: at least 15 major specialities divided according the specialties of doctors and specific diseases (Chonburi Hospital 2013). Chonburi Regional Hospital had 2,586 healthcare providers in total, in 2012. The nursing cadre had the highest number: 531 in 2012: however, this number represented a slight decline (2%) from 548 in 2011, and 536 in 2010 (Annex 15).

Chonburi Regional Hospital does not assign a particular day for the HIV clinic, as with other diseases. They provide the opportunity for PLHIV to walk in to access the HIV treatment service every day, with two entrances which allow PLHIV to maintain privacy.

Focusing on the ART services, Chonburi Regional Hospital sited the ART clinic separately as a one-stop service, in two large connected rooms at one corner of the hospital. There are two entrances to the ART clinic. One door was in the OPD, where many patients were waiting for other clinics, but which allowed PLHIV to enter the clinic without it being obvious where they were going. The other entrance was in front of the

OPD area, next to the parking area of the hospital: from this entrance PLHIV can access the clinic directly from the front of the hospital.

From an observation and a structured interview, using the data record form shown in Table 3 in Annex 16, I found that Chonburi Hospital allows patients to access ART services on any working day; this is for patients who walk into the hospital without an appointment with the ART clinic doctors set specific quarterly appointments to follow-up patients' heath status, the clinical outcome of their treatment, and to refill their ARV drugs.

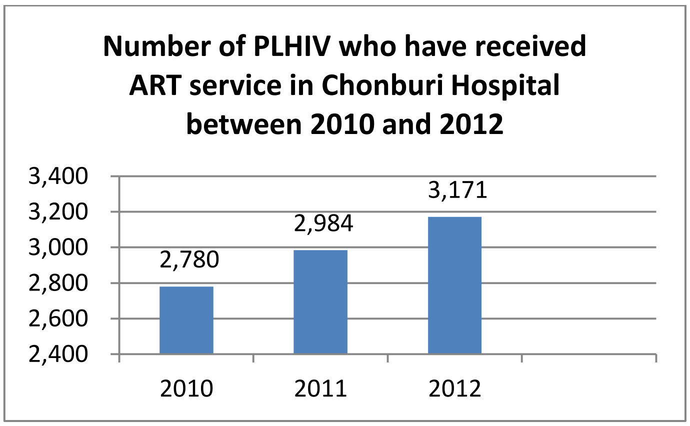
Chonburi Regional Hospital provided services for about 50-100 PLHIV per day; mainly provided on three days (Tuesday to Thursday); from 8 a.m. to 1 p.m. On Tuesdays and Thursdays there were evening clinics from 5 p.m. till 7 p.m., mainly for government officials who could not attend in the daytime. The Wednesday evening clinic was replaced by one on Sunday, from 1 p.m. till 3 p.m. This clinic allowed any PLHIV who wished to avoid contact with the groups attending on other days.

At the ART clinic, there were three medical doctors with 15 years' experience of treating HIV. There were also two pharmacists and two pharmacist's assistants to provide ARV drugs. In the laboratory team, there were six technicians (from 12 laboratory technicians in total) providing laboratory tests for ART services. The last key person was a counsellor; just one, who was a nurse with counseling training, responsible for ART and other healthcare services.

4.5.2 Data on PLHIV receiving ART service

Figure 4.10 shows the number of PLHIV receiving ART services between 2010 and 2012. There was increasing trend of number of PLHIV accessing to ART service. In 2012, Chonburi Regional Hospital provided these services for 3,171 PLHIV.

Figure 4.10 Number of PLHIV receiving ART services at Chonburi Regional Hospital (2010 to 2012)



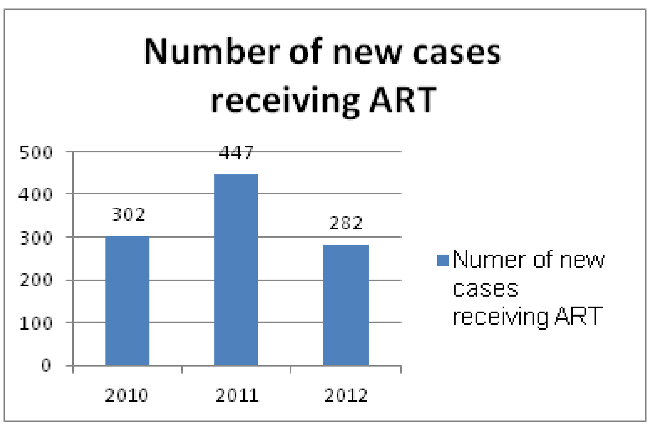
Source: ART clinic at Chonburi Regional Hospital in 2012

Chonburi Regional Hospital provided pre-test counselling for each patient to check HIV status, CD4 count, and liver and kidney function tests, as other hospitals have done, following the national practice guidelines (Bureau of AIDS, TB, and STIs 2004; European AIDS Clinical Society (EACS) 2011; 2007; Sungkanuparph et al. 2010; Teeraratkul et al. 2008). PLHIV would be counted and scheduled for access to ART services. However, some of them still had a high CD4 count, meaning it was too early to receive ARV drugs according to the national guideline recommendations. Those PLHIV who were not eligible to be treated with ARV drugs would have their CD4 counts checked every six months.

There were other groups of patients who, after their HIV positive status was confirmed, were also not ready to be treated with ARV drugs; for instance, those with opportunistic infections which needed to be treated until their health status and clinical outcome had improved.

In 2010, there was a large gap between the number of PLHIV accessing ART services and those receiving ARV drugs; 3,430 and 2,780 PLHIV. However, the gap had narrowed in 2011 and 2012: In 2012, there were only about 130 PLHIV waiting to receive ARV drugs. The percentage of PLHIV who had received the drugs increased to 81.05, 88.34 and 96.03 %, in 2010, 2011 and 2012, respectively.

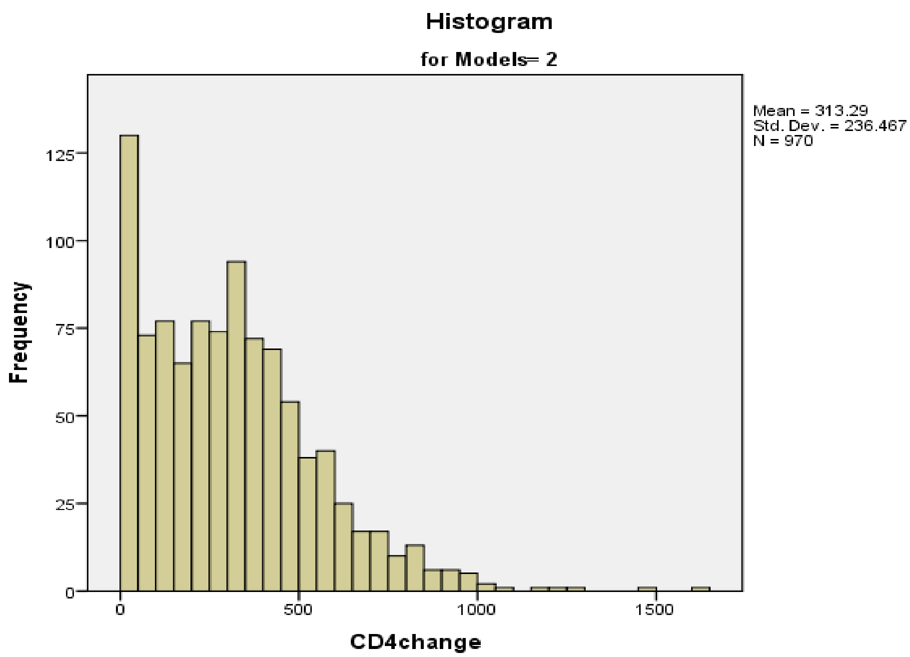
Figure 4.11 New cases receiving ART services at Chonburi Regional Hospital (2010 to 2012)



Source: ART clinic at Chonburi Regional Hospital in 2012

In 2010, 302 PLHIV (10.52 % of total PLHIV numbers) were new cases who received ART services at Chonburi Regional Hospital (Figure 4.11). In 2011, the hospital recorded an increased trend of new cases receiving the drugs. However, in 2012, there was a reduced trend of new cases. In this year, there was an increasing trend of new cases of PLHIV accessing care with a higher CD4 count: 201-350 (51.22%), as well as all other groups of CD4 count levels, except the group with a CD4 count of 51-200 cell/mm^3: this group showed a decreased trend among new cases.

Figure 4.12 Changes in CD4 count of PLHIV at Chonburi Regional Hospital after receiving ART, September 2012

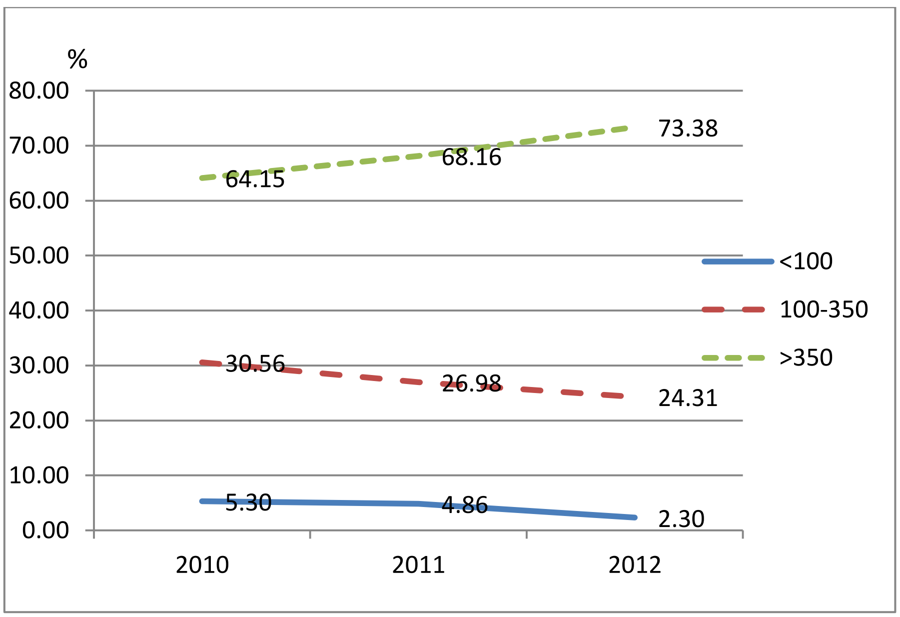


Source: ART clinic at Chonburi Regional Hospital in 2012

Figure 4.12 shows differences of CD4 count before PLHIV received ART service and the latest level in 2012. Most PLHIV had CD4 count higher than the CD4 count when they had not received ART servce.

It is clear from Figure 4.13 that the longer PLHIV take ARV drugs, the higher their CD4 count. This figure presents for the change of CD4 count for PLHIV how have been followed up at least 6 months which does not include the 14 PLHIV who were new cases of ART service.The number of PLHIV having a CD4 count lower than 100, and in the range 100 – 350 cell/mm^3 followed a downward trend from 152 (5.30%) to 73 PLHIV (2.30 %) and 30.56 to 24.31% in 2010 to 2012, respectively. Similarly, there was a declining trend of PLHIV with a CD4 count 101 to 350 cell/mm^3, from 877 (30.56%) to 771 (24.31%) PLHIV between 2010 and 2012, respectively. Conversely, there was an increased trend of PLHIV with a CD4 count higher than 350 cell/mm^3, from 1,841 (64.15%) to 2,327 PLHIV (73.38%), from 2010 to 2012, respectively.

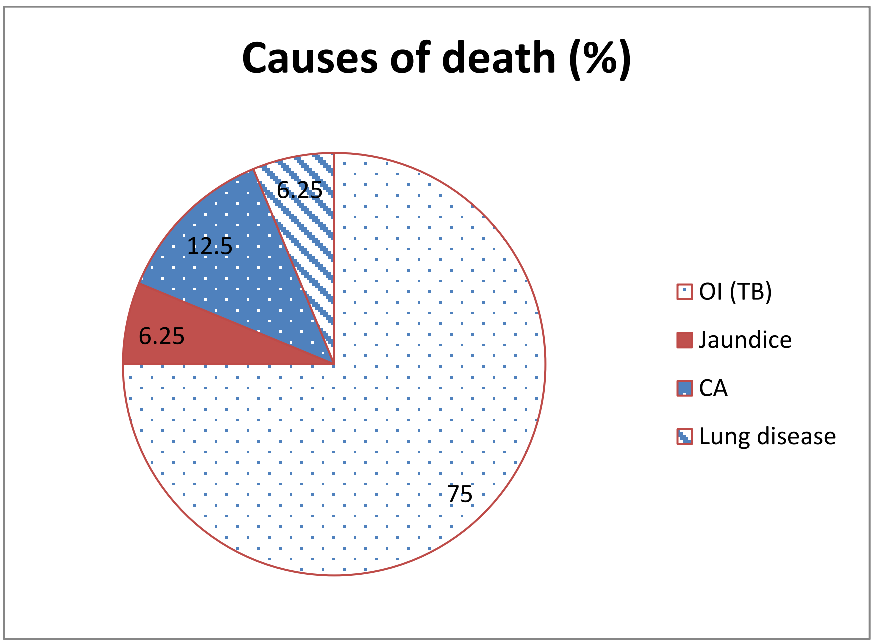
Figure 4.13 Ratio of PLHIV receiving ART at Chonburi Regional Hospital in different level of CD4 count (2010 to 2012)



Source: ART clinic at Chonburi Regional Hospital in 2012

Turning to the PLHIV who were lost from the ART services, some had actually died during the time when they were receiving ARV drugs: 14 in 2010, 9 in 2011 and 16 in 2012, representing about 0.5%, 0.3% and 0.5%, respectively, of the total number of PLHIV receiving ARV drugs during the period. In 2012, the most common cause of death for PLHIV at Chonburi Hospital was opportunistic infection (Tuberculosis (TB)) accounting for 12 out of a total of 16 deaths (75%); of the other four, two died of cancer and two from jaundice and renal failure (Figure 4.14).

Figure 4.14 Causes of death (%) of 16 PLHIV at Chonburi Regional Hospital in 2012

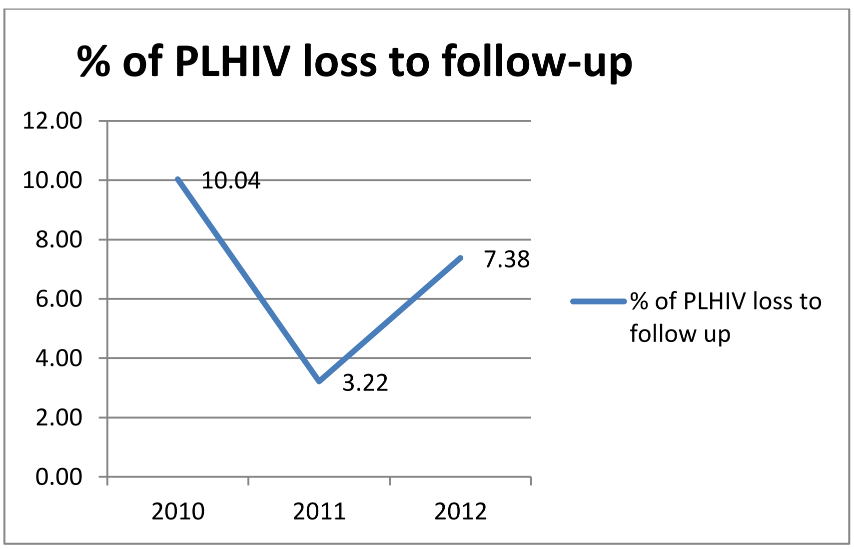


Source: ART clinic at Chonburi Regional Hospital in 2012

Other data shows the loss to follow-up of PLHIV from the ART service: this data particularly indicates the quality of care of the service at Chonburi Regional Hospital. The range of 3-10% meant that on average there were about 100-300 PLHIV lost to follow-up from the ART services at Chonburi Regional Hospital. From 2010 to 2012, there were 279 (10.04%), 96 (3.22%) and 234 (7.38%), respectively, PLHIV lost from the service (Figure 4.15).

The staff at the ART clinic checked daily for any missed appointments, in which case they called PLHIV that could not get in touch. The most common reason for loss to follow-up is the disappearance of the clients.

Figure 4.15 Loss to follow-up rate of PLHIV receiving ART services at Chonburi Regional Hospital (2010 to 2012)



Source: ART clinic at Chonburi Regional Hospital in 2012

4.5.3 Analysis of task allocation for ART services at Chonburi Regional Hospital

The data record form (Annex 16) was used to collect and analyse the data of task allocation for ART services. I interviewed three doctors who were the main providers of ART service for PLHIV. Annex 16 (part 2) shows the checklist of activities of ART services at Chonburi Regional Hospital. Seven main points of the services are analysed as follows.

4.5.3.1. Registration

Three non-healthcare workers, paid by the hospital, provided registration services from 8.00 a.m. to 13.00 p.m. The first member of the registry staff received and checked appointment cards and then registered and placed PLHIV in a queue to be examined by the doctor in the treatment room. The second member of the registry staff prepared PLHIV profiles using the appointment cards and the results of pre-appointment laboratory tests. The third staff member took patients' blood pressure, weight and waist measurement, and collected and prepared patient profiles on the afternoon of the day before an appointment.

4.5.3.2. Preparing PLHIV profiles (OPD cards) and documents for diagnosis and prescription of ARV drugs

After registry services, the staff needed to update OPD cards with laboratory test results, before doctors met the patients. A hard copy of the appointments for the next three months also had to be attached. Staff had to complete all information that doctors required for diagnosis and treatment by 9.00 a.m. The ART clinic provided ART services between 8.00 a.m. and 1.00 p.m., and conducted administration activities in the afternoon in preparation for the next day. Additionally, they had to prepare prescriptions, usually a matter of refilling three-months-worth of pre-prescribed drugs.

4.5.3.3. Screening, diagnosis and treatment

There were three medical doctors having over 20 years' experience of ART, the other two doctors had over fifteen years' experience sharing the responsibility for providing ART services at an ART clinic. They took responsibility for delivering the ART services on different days, but on Tuesdays two doctors shared this responsibility. PLHIV were seen and received the ART services of symptom screening, diagnosis and treatment from doctors. Patients who missed an appointment had to make new appointments with registry staff, but only doctors had the authority to prescribe or refill ARV drugs.

4.5.3.4. Drug dispensing

Two pharmacists provided the drugs, helped by two pharmacy technicians. They read the prescriptions, prepared and packaged the ARV drugs, which were given to the patients along with necessary information including indications, contra-indications, possible adverse reactions and the necessity of good adherence to the drug regimen. The pharmacy team arranged and packed ARV drugs and kept them in different coloured baskets for efficient management.

4.5.3.5. ART service counselling by counsellor

I observed and interviewed a counsellor with a professional nursing background, who provided counselling to PLHIV who were new to taking ARV drugs. She also provided counselling for patients with other illnesses; for example, tuberculosis, psychosis and depression. This service was provided every working day. Generally, she took between half-an hour to an hour to couselling each case of PLHIV.

4.5.3.6. ARV drug counselling by pharmacists

Pharmacists also provided ARV drugs counselling for cases of PLHIV new to these drugs or PLHIV who had ART complications since being prescribed new ARV drugs or a new regimen. Doctors would write a note on a prescription, asking the pharmacist to please provide ARV drug counselling. Pharmacists provided this counselling in a separate closed room.

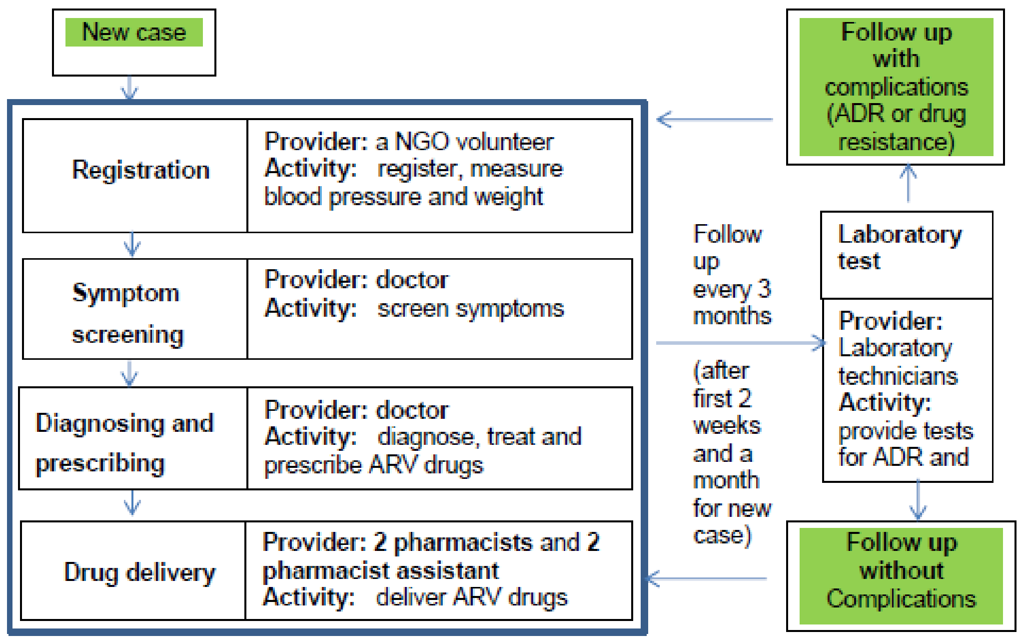
4.5.3.7. Laboratory testing

Laboratory technicians and other people in the team integrated their work for all kinds of diseases. Timetables were scheduled to run the machines and conduct testing as routine work. PLHIVs with an appointment for laboratory testing were asked to have blood testing (chemistry, liver and kidney function tests, hematology, etc.) in the early morning, before meeting doctors or nurses. Some PLHIVs were asked to have laboratory testing after meeting a doctor; however, the laboratory team could report the results of testing to doctors and PLHIV within half an hour on the same day.

4.5.4 Flow of ART services at Chonburi Regional Hospital

New cases met the registry team to record body weight, blood pressure and waist measurement. Then, the doctor provided all the details of treatment to the new patient and prescribed ARV drugs, patients then left the ART clinic and went directly to the pharmacy unit to receive their drugs. The pharmacy team delivered the drugs from the counter of the pharmacy unit, and the new patient was told to wait for another pharmacist to provide ARV drug counselling in the ARV drug counseling room. After the patient had received their drugs and understood the information they had been given by the pharmacist, they returned to the ART clinic to practice measuring the correct dose of ARV drugs for themselves in front of a doctor. The new case became a PLHIV, with follow-up appointments at the ART clinic every 3 months; but the first appointment only took place after two weeks and then one month, to allow the doctor to ascertain that there was a stable outcome of treatment to the new therapy. Once this was established, appointments moved to three-month intervals (Figure 4.16).

Figure 4.16 Flow of ART services at Chonburi Regional Hospital



4.5.5 Time required to provide ART services at Chonburi Regional Hospital

I observed and analysed ART activities with six tasks, as follows. The SPSS statistical analysis was applied. The normality tests of either Kolmogorov-Smirnov or Shapiro-Wilk show that the time required to provide all elements of ART service is not normal distribution (P-Value <0.05), Annex. Means of the time required to provide each activity of ART services presented in Table 4.8. There is only an activity of registration has no difference among mean of time required to provide ART service.

Table 4.8 Mean comparisons of time required to provide ART services to the three groups of PLHIV, categorised by treatment outcome of PLHIV atChonburi Regional Hospital, September, 2012

Groups of PLHIV categories by outcome of treatment (984 cases)	**Time required to provide ART services by activities (mean + SE)****			
	Registration	**Symptom screening and Diagnosis**	**Drug delivery**	**Total**
Normal (898 cases, 91.26%)	1.06 ± 0.01	2.41 ± 0.05*	2.64 ± 0.03*	6.11±0.668
Complications (72 cases, 7.32%)	1.08 ± 0. 03	6.76 ± 0.43	3.20±0.13*	11.05±0.46
New case (14 cases, 1.42%)	1.07 ± 0.07	5.79 ± 0.65	4.29 ±0.20*	11.14±0.80
Average of time required for healthcare providers to deliver ART services (984 cases)				**6.54 ± 2.58**

Note ***** refers to the significant difference at P-Value ≤0.05

** Transit times were not included

The group of PLHIV who followed up without complications required the least time and significant difference ($p \leq 0.05$) compared with the other two groups (followed up with complication and new cases. The results of mean comparisons of the time required to provide each activity of ART services, during the whole month of field work there, show that the activities of diagnosis and drug delivery show a significant difference of mean compared among the three groups' different treatment status. For the drug delivery element, the time required to provide the service to a group of new case PLHIV is the highest, significantly, ($p \leq 0.05$).

The findings of the ART model of Chonburi Regional Hospital, representing regional levels of care,show that the doctor-led the ART team, by taking on most of the main activities of the ART services, including symptom screening, diagnosis and prescribing ARV drugs. Other actives at the ART clinic were provided by non-healthcare providers: data management and preparation of PLHIV profiles and results of laboratory tests. This model required on average about 6-7 minutes of time to deliver ART service to PLHIV which is lower than the first model in Sanpatong district (community-based model). Focusing on the quality of care, in the doctor-led model, PLHIV receiving ART service showed an increasing trend of raised CD4 level; however, this model had a higher rate of loss to follow up comparing with previous model; the community-based model (Sanpatong District Hospital). It was possible that there was no system to follow them, but by phone, as explained in this section.

4.6 PRACHUAP KHIRIKHAN PROVINCIAL HOSPITAL: MIXED-COMPREHENSIVE CARE MODEL

4.6.1 Description of the services

Prachuap Khirikhan provincial hospitalis called a mixed-comprehensive model because of the activities and mix of healthcare and non-healthcare providers providing ART services at the ART clinic, as explained in Section 4.6.2. The other two models of care had a mix in the types of healthcare provider delivering ART service. However, they did not count as ‘comprehensive’, because the mixed-comprehensive model of care had the participation of non-healthcare worker, who, along with healthcare workers, organised group meetings for PLHIV. This was not found in the other two models.

Prachuap Khirikhan Hospital is a provincial facility level of care. It is one among 69 general hospitals under the direct authority of the Ministry of Public Health (Ministry of Public Health 2008). The hospital has 300 beds for the provision of healthcare services. Prachuap KhiriKhan Hospital is located in the first province in the southern region of Thailand. People in the province have a wide range of careers. However, there are a large number of fishermen and people who have migrated from countries neighbouring Thailand such as Myanmar. When I was at Prachuap Khirikhan Hospital, I used the data record form to collect the data and information that I needed. In 2012, this hospital had a total of 556 healthcare providers. The nursing cadre had the highest number of staff. There was small increasing trend of number of nurses since 2010 whereas others had remained steady. Annex 18 shows the data record form part one, summarising data collected about the hospital and the number of healthcare providers.

Prachuap Khirikhan Hospital held an ART clinic only once a week, on Thursdays, from 8 till 12 in the morning, and 1 till 4 in the afternoon. Five healthcare providers delivered ART services. The hospital had an NGO-supported volunteer healthcare worker providing ART services with the hospital team. The doctor in the ART clinic had over 20 years experience of ART, providing diagnosis and treatment, and prescribing ARV drugs for PLHIV.

Prachuap Khirikhan had a pharmacist with 15 years experience in delivering ART services, mainly for PLHIV who had a stable treatment outcome without complications. He studied clinical therapy for his master degree which major in ART and the treatment of other communicable diseases. The doctor had delegated tasks such as diagnosis and the prescription of ARV drugs to him, but when there were serious cases involving complications, he instructed patients to see the doctor in the afternoon.

Patients received pre- and post-test counselling from a counsellor, who provided important information for PLHIV about to start ARV drugs; but before they began taking the drugs they were placed in a group, which allowed them to meet other PLHIV, to share information about HIV/AIDS and ART services, and where they could be open about their health status. Because they would be taking ARV drugs for the rest of their lives, it was important that they had good adherence to their regimen. To ensure this, they practised with vitamins before taking the real ARV drugs. They were then evaluated by a team of healthcare providers to ensure that they were ready to start taking ARV drugs, after which they would be given an appointment to meet healthcare providers at the Thursday clinic in the following month.

On the Thursday morning, in the meeting room, PLHIV met the team of two NGO volunteers, who registered them, measured and recorded their weight and blood pressure, and screened their symptoms. Then they were sent to the ART clinic which was held in two medical rooms in the OPD of the hospital, in order to receive other ART services.

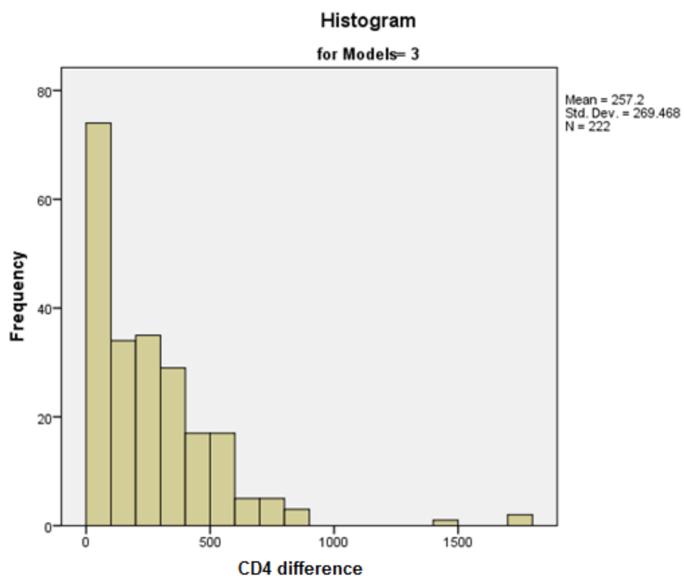
Activities at the ART clinic of Prachuap Khirikhan Hospital were observed every Thursday between 13th September and 25th October, 2012. On each occasion, the ART clinic provided services to about 50 PLHIV. They were put into groups by the team of healthcare providers. Temporary non-professional health workers, paid by the government, had prepared OPD cards on Wednesday evening.

Early on Thursday morning, the pharmacist previously described, who was qualified to provide ART services, would ask the pharmacy team (of a pharmacist and an assistant) to prepare repeat-prescription ARV drugs for PLHIV whose clinical response to treatment was stable. The pharmacist would also meet PLHIV in medical room, and provide symptom screening, diagnosis, evaluation and measurement of drug adherence status, and prescribe ARV drugs insteadof the doctor, during the morning. If he found that PLHIV had complications, or symptoms that needed investigation by the doctor, he instructed them to wait to see the doctor in the afternoon. 460, 480 and 556 PLHIV received ART services at Prachuap Khirikhan hospital in 2010, 2011 and 2012, respectively.

4.6.2 Data on PLHIV receiving ART services

Most of these PLHIV had CD4 counts at high levels after they received ART service Figure 4.17 shows differences of CD4 count of PLHIV between before and latest level in 2012.

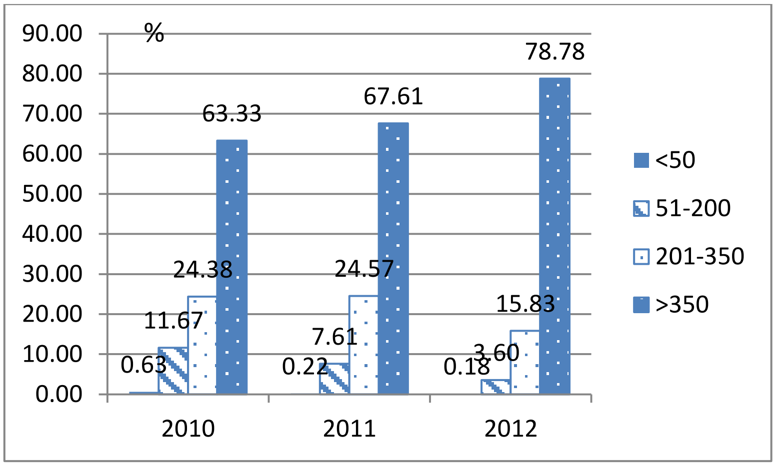
Figure 4.17 Changes in CD4 count of PLHIV at Prachuap Khirikhan Provincial Hospital after receiving ART and the latest level, October 2012,



Source: ART clinic at Prachuap Khirikhan Provincial Hospital in 2012

Data from 2010 to 2012 showed PLHIV with CD4 counts higher than 350 cell/mm^3, with an increased trend between 2010 and 2012, similarly to the group of PLHIV with CD4 counts in the range of 201-350 cell/mm^3. By contrast, PLHIV with a CD4 count at a lower level had a decreased trend, (Figure 4.18).

Figure 4.18 CD4 count of PLHIV receiving ARV drugs from Prachuap Khirikhan Provincial Hospital (2010 to 2012)



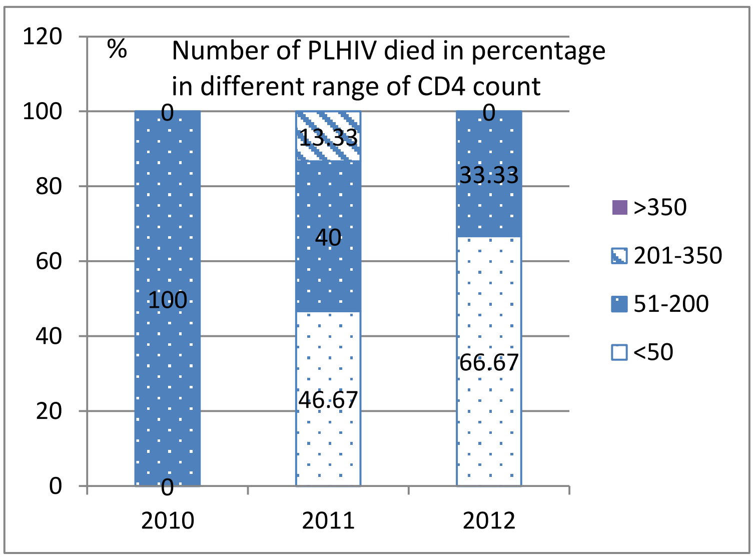
Source: ART clinic at Prachuap Khirikhan Provincial Hospital in 2012

The ART clinic provides ARV drugs to about 150 new cases a year (Annex 18) Considering the CD4 count in both 2011 and 2012, most of the new cases (about 50 %) had a CD4 count of over 350 cell/mm^3 followed by those with a CD4 count in the ranges of 201-350 and 51-200 cell/mm^3, at about 25% and 27 %, respectively. There was only one new case PLHIV with a CD4 count lower than 50 cell/mm^3.

Focusing on the rate of loss to follow-up of ART services, about 10 PLHIV who had received ARV drugs at Prachaub Khirikhan Provincial Hospital died each year: 8, 15 and 9 cases, in 2010, 2011 and 2012, respectively. Cause of death was from opportunistic infections, for example tuberculosis. Most PLHIV who died had a CD4 count lower than 50 cell/mm^3. In 2010, all 8 PLHIV who died had a CD4 count in the range of 51-200 cell/mm^3 (Figure 4.19).

Considering the loss to follow-up rate of Prachuap Khirikhan Hospital, the ART team reported no PLHIV lost to follow-up except those who had died. This is because healthcare providers called any PLHIV who had missed an appointment, before the clinic closed. If they were unable to contact them by phone, the two NGO volunteers would visit their homes, and could also contact them through their PLHIV groups.

Figure 4.19 Numbers of PLHIV of Prachuap Khirikhan Provincial Hospital died (2010 to 2012)



Source: ART clinic at Prachuap Khirikhan Provincial Hospital in 2012

4.6.3 Analysis of task allocation for ART services at Prachuab Khirikhan Provincial Hospital

The data record form (Annex 18 part two), with checklists to collect data and information about the activity of task allocation for ART services, were used to collect the data. The six main activities are generally analysed.

4.6.3.1. Registration

The NGO volunteers prepared health information about PLHIV in the group on the evening before the day of the ART clinic. They checked the lists of PLHIV, matching results of laboratory tests as needed. On the day of the ART clinic, from 8.00 a.m., PLHIV with appointments joined a group meeting in the meeting room. Confidentiality is compromised by group discussions, but there is the corresponding advantage of group support. At this meeting, PLHIV were registered by healthcare providers and two NGO volunteers, and then had their blood pressure and weight recorded by the NGO volunteers. After this they were interviewed to monitor and evaluate their adherence to ARV drugs.

4.6.3.2. PLHIV group meeting

The group meeting was conducted by a team of healthcare professionals and the two NGO volunteers between 8.00 and 12.00 a.m. PLHIV were assigned to groups comprising 50 PLHIV; the ART clinic of Prachuap Khirikhan Hospital has 60 of these groups. The other main activities of the ART team were the sharing of information about HIV epidemiology, prevention, treatment and good adherence to ARV drugs. PLHIVs were asked to share their experiences with the other patients in their group.

The goup meeting was set for the benefit of peer and networking. The disclosure approach is the concern of PLHIV. The PLHIV were required to disclose their HIV/AIDS statuses to other PLHIV in the same group. This means a loss of privacy, but, as previously mentioned, PLHIV receive benefits which, on balance, compensate for this loss. For instance, the PLHIV in the same group shared their feelings and experiences during their ART; this sharing may be beneficial to other PLHIV who are facing difficulties or problems when taking ARV drugs, helping them to achieve good adherence.

NGO volunteers also made home visits to new cases and patients who had complications from the treatment, in order to prevent loss to follow-up and promote good adherence to ARV drugs in order to minimise the likelihood of drug resistance.

4.6.3.3. Diagnosis, treatment and prescribing

A specific pharmacist provided symptom screening, diagnosis, treatment and the dispensing of ARV drugs. These tasks had been delegated to the trained pharmacist by the doctor. Any patients exhibiting complications were asked to wait until the afternoon when the doctor was available in person; and they could be diagnosed, receive treatment and be prescribed ARV drugs, along with new patients.

4.6.3.4. Drug dispensing

This activity was handled in two ways. For the most part, the pharmacy team prepared and refilled drugs for those PLHIV with stable clinical outcomes at the ART clinic in the morning after the group meeting. PLHIV with treatment complications and patients new to ART received their drugs in the afternoon.Two pharmacists and two pharmacist assistant took responsible for this activity.

4.6.3.5. HIV Counselling

Counselling was delivered each working day by an HIV-qualified professional nurse, in the OPD on the days when the ART clinic was not open. This enabled PLHIV to access services as conveniently as possible. The OPD clinic was open every day. If those PLHIV were new cases, they were put in a group with other new cases of PLHIV and met the doctor and ART team on Thursdays. The counsellor would also provide group counselling in the meeting room every Thursday. Each counselling session took between half an hour to an hour.

4.1.3.6. Laboratory testing

This service was delivered by the team at the laboratory in the central unit of the hospital. This team provided many services related to HIV/AIDS. People were able to walk in directly to check their HIV status. The laboratory team carried out other important services for the ART clinic, including routine tests of blood, liver and kidney function and measurements of cholesterol, triglycerides and blood sugar. PLHIV with appointments for laboratory testing were asked to have these early in the morning before the group meeting or other activities, in order that the test results were available to the ART team; however, some tests were conducted after consultations with the pharmacist or doctor, the results being reported to doctor and patient within half an hour.

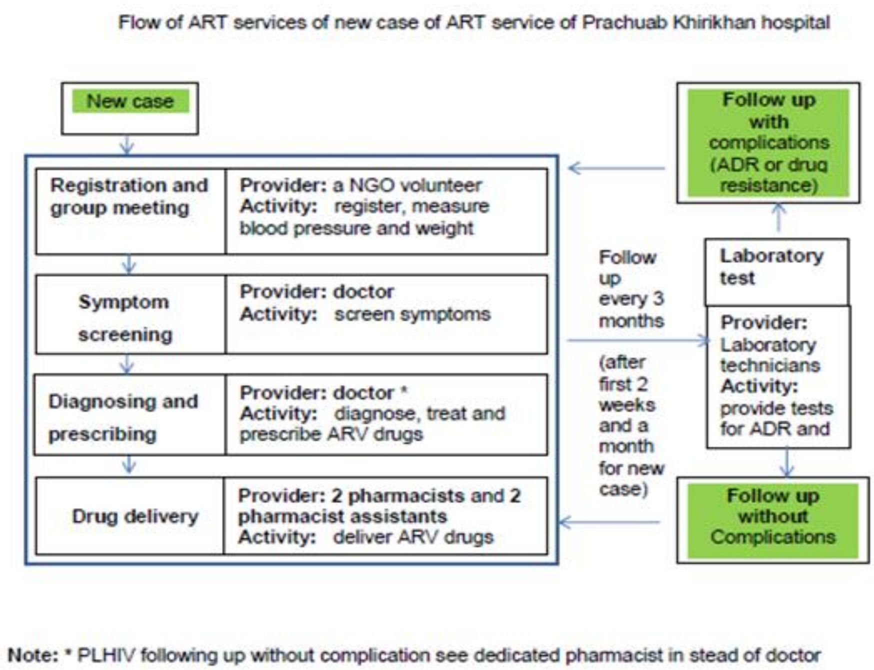
4.6.4 Flow of ART services at Prachuab Khirikhan Provincial Hospital

The management team of the ART clinic made decisions in order to match patients with a suitable group whose members would help and support each other and make them feel they were not alone. This group support made it easier for healthcare providers and NGO volunteers to follow-up patients. All PLHIV receiving ARV drugs, including new cases, received home visits from the NGO volunteer team, which helped and supported them in having good adherence to the drugs, and monitored them for any difficulties taking ARV drugs or ADR. The NGO volunteers had a strong network across the country; in 2012 there were 440 groups of NGO volunteers helping PLHIV across the country. Several NGO networks co-operated in order to support PLHIV access to ART services and receipt of ARV drugs. These networks had a vertical model of organisation; with chairmen at national and regional levels, and heads at provincial level. They were funded by charitable donations and by the government, but they had to propose their project to receive funds.

"On the day of the ART clinic, PLHIV in the same group met each other in the meeting room. New cases were provided with orientation of the ART service and told what they would receive from the services and what they had to do now that they have started taking ARV drugs. They joined the group meeting which took place from 8.00 a.m. until 12.00 p.m. Teams of healthcare providers: nurses, pharmacist, counsellor and NGO volunteer gathered in the meeting room giving out information about the prevention and treatment of HIV/AIDS infections, ART services, ARV drugs, ADR to ARV drugs, good adherence to ARV drugs and drug resistance. This was to ensure that new cases would have good adherence to the drugs, and would come to follow-up checks at the ART clinic each month" (designated pharmacist).

New cases requiring ART were given an appointment two weeks after starting ARV drugs; if after this period there were no complications of treatment, the doctor would make the next appointment for a month's time, the same as for other groups of PLHIV who followed up without complications. For PLHIV who followed up with complications of treatment, the doctor would make appointments for every two weeks or even every week until the outcome of the treatment was stable (Figure 4.20).

Figure 4.20 Flow of services for new cases at the ART clinic of Prachuap Khirikhan Provincial Hospital



Source: ART clinic at Prachuap Khirikhan Provincial Hospital in 2012

PLHIV who followed up at the ART clinic when they were no longer new cases met their treatment groups in the meeting room on the morning of their appointment day. The NGO volunteer registered patients and measured weight, blood pressure and adherence to ARV drugs. PLHIV then queued to see the pharmacist for diagnosis and treatment, the first case being seen at about 10.00 a.m. The pharmacist, not the doctor, was responsible for screening, diagnosis, treatment and dispensing of ARV drugs to PLHIV with a stable treatment outcome, and those with only minor complications which did not necessitate a change to the ARV regimen, or blood sampling to test for drug resistance.

Before the pharmacist met PLHIV he had to update patient profiles with the results of laboratory tests, using a computer application. He then prescribed one-month repeat prescriptions for ARV drugs, which were prepared and packed by his pharmacy team. At about 10.00 a.m., he met PLHIV in person, to screen symptoms, diagnose, treat and dispense ARV drugs. If he found treatment complications that he was either unable to treat, or that he considered serious enough to call for the doctor's attention, he would arrange for the patient to see the doctor in the afternoon. PLHIV then returned to their group in the meeting room, to book their next appointment with the team of NGO volunteers, before going home; the NGO volunteers would reiterate the importance of good adherence to the drug regimen.

Doctor's appointments took place from 1.00 p.m. onwards, with the assistance of a professional nurse. PLHIV were diagnosed, laboratory tests arranged and ARV drugs prescribed. Any PLHIV who had not had blood testing in the morning had to do so now, wait for the results and return with them to the medical room for the doctor to respond with the appropriate treatment. These activities concluded at 16.00 p.m.

4.6.5 Time required to provide ART services at Prachuab Khirikhan Provincial Hospital

SPSS Statistical analysis was applied for mean comparison of the time required to provide ART services at Prachuap Khirikhan Provincial Hospital (Annex 19). Data of the time required to provide the registering element of the ART service was applied to be tested for normal distribution. The result of P-Value test for normal distribution with Kolmogorov-Smirnov and Shapiro-Wilk is at 0.001, which is lower than P-Value at 0.05 (reject hypothesis): thus, the time required to provide all the elements of the ART service is not normal distribution. The statistical analysis set is applied with a non-parametric test and with an independent sample test.

Table 4.9 presents the results of mean comparisons of the times required to provide each activity of ART services. The result shows that only the activity of diagnosis shows a significant difference of mean among the three groups. PLHIV following-up without complications required the least time compared to the other two groups, significantly (P-Value $\leq$ 0.05). This result is similar to the results of time taken for diagnosis in the other two models of care.

Table 4.9 Times required to provide ART to each treatment outcomegroup at Prachuap Khirikhan Provincial Hospital, October, 2012

Groups of PLHIV categorised by treatment outcome (235 cases)	**Time required to provide each activity of ART services (mean + SE)**			
	Registration	**Symptom screening and Diagnosis ***	**Drug delivery**	**Total ***
Normal (204 cases, 86.81%)	1.01 ± 0.01	2.94 ± 0.12	2.14 ± 0.05	6.09 ± 0.14
Complications (18 cases, 7.66%)	1.00 ± 0. 07	9.00 ± 0.96	2.75± 0.25	12.75 ± 0.10
New case (13 cases, 5.53%)	1.08 ± 0.08	10.15 ± 1.18	2.12 ± 0.32	13.35 ± 1.23
Average of time required for healthcare providers to deliver ART services (235 cases)				**7.00 + 3.39**

Note ***** refers to the significant difference among the three groups of PLHIV at P-Value ≤0.05

The non-parametric test with Kruskall-Wallis test for independent sample was selected for comparing the mean of time required to provide ART services in the three different models of care (Annex 20). The hypothesis of the comparison is that there is no difference among the three different groups of PLHIV: reject null hypothesis at (P-Value ≤0.05). The results of the test show that there are differences in the means of the time required to provide ART services among the three models of care, for each activity, and for the total times of the ART service (P-Value ≤0.05).

4.7 SUMMARY OF MAIN FINDINGS

Table 4.10 The comparision of four aspects among three models of care

Main aspects of comparison	**Model 1: Sanpatong District Hospital and sub-district hospitals (Community-based model)**	**Model 2: Chonburi Regional Hospital (Doctor-led model)**	**Model 3: Prachuap Khirikhan Provincial Hospital (Mixed-comprehensive model)**	**Comparisons between and within groups**
1.Staff input and task allocations	Main tasks: diagnosis, treatment and prescribing delivered by doctor; shifted from doctor to nurses to follow up PLHIV with no complications fromtreatment at district hospital. District hospital transferred PLHIVs with stable treatment outcome to be followed up at sub-district hospitals. Registration, and blood pressure and weight measurement tasks shifted from nurses to NGO volunteers.	Main tasks: diagnosis, treatment and prescription delivered by doctor. Registration, and blood pressure and weight measurement shifted from nurses to NGO volunteers.	Main tasks: diagnosis, treatment and prescription delivered by doctor: shifted from doctor to nurses or pharmacist to follow up PLHIV with no complications. Registration, and blood pressure and weight measurement shifted from nurses to NGO volunteers. Support from NGO volunteers who provide group counseling and update information and knowledge of ART treatment and policy.	1. Models 1 and 3 shifted some tasks from doctors to other professions. Model 2, all tasks of ART service (except diagnosis, treatment and prescribing) were shifted from healthcare providers to non-healthcare providers. 2. In all models, non-healthcare workers provided registration and measurement of weight and blood pressure. 3. Model 3 only: group meeting of PLHIV for group counselling; updating of ART knowledge and policy; monitoring and evaluating adherence to ARV drugs.

2.Key characteristics of each model	Task-shifting applied within district hospital; tasks of ART service delegated from district hospital to sub-district hospital following the decentralised policy. 1. At district hospital, doctor shifted tasks to nurses to provide ART services for PLHIV following up without complication. 2. Decentralised policy, district hospital referred PLHIV following up without complications to sub-district hospitals, where ART tasks delivered by nurses shifted to nurses and community healthcare workers 3. Sub-district hospitals integrated ART services with home visits for other illnesses. Healthcare providers at sub-district hospital could build relationships with PLHIV in area: better than passively waiting for PLHIV to visit hospital of own volition.	Doctors provided most ART activities with support of non-healthcare workers paid by hospital. 1. Doctors led and organised ART clinic team. 2. Non-healthcare providers prepared documentary support needed for diagnosis, treatment and prescription of ARV drugs. 3. No home visits to PLHIV.	Mix of healthcare providers as in Model 1; participation of non-healthcare providers to provide group meeting for PLHIV as part of ART service. 1. Doctor shifted tasks to pharmacist or nurse for PLHIV following up without complication. 2. Healthcare and non-healthcare providers (NGO volunteers) held group meeting for PLHIV in meeting room before doctors appointments. 3. Healthcare provider put PLHIV in follow-up groups. Group members had appointments on same day. PLHIV required to disclose HIV positive status to other PLHIV in group, to join activities during meeting, and be followed up at home by healthcare providers and NGO volunteers in ART team.	1. All three models of care applied task-shifting; differences in specific context of each model. 2. In two models of care NGO volunteers followed up PLHIV at home and carried out other activities; not in doctor-led model. 3. Only model 3 had group meetings for PLHIV, and organised PLHIV into follow-up groups for each hospital visit.
3.Output (patient seen, test done) 3.1 PLHIV cohort characteristics	1. Most (88.27%) had stable treatment outcomes; 10.75% had complications from treatment; 0.98% were new cases (first column of Table 4.2). 2. After first ART treatment, most (66%) CD4 levels were higher than 350 cell/mm^3; 23.40% were between 200-350 cell/mm^3; 10% were lower than 200 cell/mm^3 (Figure 4.3).	1. Most (91.26%) had stable treatment outcomes 7.32 % had treatment complications; 1.42% were new cases (first column of Table 4.19). 2. After first ART treatment, most (73.38%) CD4 levels were higher than 350 cell/mm^3, 24.31%were between 100-350 cell/mm^3, 2.10% were lower than 100 cell/mm^3 (Figure 4.13).	1. Most (86.81%) had stable treatment outcomes; 7.66 % had treatment complications; 5.53% were new cases (first column of Table 4.10) 2. After first ART treatment, most (78.78%) CD4 levels were higher than 350 cell/mm^3, 15.83% were between 200-350 cell/mm^3, 5.78% were lower than 200 cell/mm^3 (Figure 4.18).	1. In each group nearly 90% had stable treatment outcomes. 11% in the community model had complications; 7.5% in each of the other two models 2. After first ART treatment, most (70-80%) had CD4 levels over 350 cell/mm^3.

3.2 Time required to provide ART services	On average, the district hospital provided **8.47± 3.08 minutes.** PLHIV with complications required most time: about 10.23 ± 0.60 minutes; PLHIV without complication: 8.24 ± 0.18 minutes new cases 9.78 ± 2.11 minutes, significantly, (P< 0.05).	On average this model provided **6.54±2.58 minutes.** New cases required most time: about 11.14±2.98 minutes; PLHIV with complication: 11.05±3.84 minutes; PLHIV without complication: 6.11±1.97 minutes, significantly, (P< 0.05).	In average this model provided **7.00 ± 3.39 minutes.** PLHIV with complication and new cases required most time: about 12.75 ± 0.10 minutes and 13.35 ± 1.23 minutes respectively; PLHIV without complication: 6.09 ± 0.14 minutes, significantly, (P< 0.05).	The doctor-led model required the least time to provide ART services, significantly, (P-value < 0.05); the community-basedmodel required the most. PLHIV following up with complication required the most time, following up without complication require the least.
4.Outcomes (retention of patients and accessing to ART service)	1. The retention rate in this model is high. Three cases out of 307 (0.3 %) at the district hospital were lost in 2012 (disappearance). NGO volunteers sent to their homes but could not locate. No PLHIV were lost at the sub-district hospital in the same year. 2. PLHIV following up without complication accessed ART services at Sub-District Hospitals: the lowest level of care, potentially reducing workload at the district level of care and improving accessibility to ART services. Access showed increasing trend.	1. The retention rate of this model is lower than the other two models. 234 (7.38 %) of 984 PLHIVs were lost to follow up in 2012. Non-professional hospital staff checked reasons for missed appointments by phone. This model had no NGO volunteers to visit homes as in the other two models. 2. All PLHIV had to visit the doctor to access services. 2,780, 2,984 and 3,171 PLHIV accessed ART services in 2010, 2011 and 2012, respectively. The doctor carried the entire workload improved accessibility	1. This model has the highest retention rate: no PLHIVwere lost to follow up. The ART team and NGO volunteers knew where PLHIV were because they home-visited all PLHIV who missed appointments. 2. 460, 480 and 556 PLHIV accessed ART services in 2010, 2011 and 2012, respectively, at the provincial facility of care. This could not be because of improved accessibility, a benefit of the lowest level of care facility in the community based model. However, in this model, PLHIV did access ART servicesat an increasing rate.	1. The mixed-comprehensive model had the lowest loss to follow up rate, followed by the community based model and the doctor-led model, respectively. This reflects the quality of care, retaining PLHIV in the system. 2. All three models of care presented an increased rate of access to ART services; but only the community based model allowed PLHIV to access services close to their homes.

To compare the main differences in the three models by the findings from this chapter as presented in Table 4.10, there are four main aspects that distinguished them; task allocations, PLHIV characteristics, rate of loss to follow up of PLHIV and time required in minutes of providers to deliver ART service. Furthermore, from these four different aspects, to compare the quality of ART service of these ART models (effectiveness of ART service), I argue that the two indicators; rate of loss to follow up and the increasing CD4 level of PLHIV, were best to be used as they were available to be collected in this study-design. The rate of loss to follow up was suitable because it reflected the ability and concerns of the ART team to keep track of PLHIV, and make sure they adhered to their ART: even when they missed appointments, the ART team could find them and get them back into treatment. The findings of this chapter imply that rate of loss to follow up indicates the effectiveness of quality of care among the three models. An increasing CD4 level was also a marker of the effectiveness of ART services, reflecting quality of care, becausean increase in CD4 shows PLHIV are complying with their drugs regimen. Although PLHIV bear much of the responsibility for their own health bythis compliance, the quality of treatment and effective education which encourage it are the responsibility of the ART team. An increasing CD4 level alone cannot guarantee the effectiveness of a model of care, but it is an indicator of quality, which will improve treatment outcomes for PLHIV.

The community-based model (Sanpatong), in which ART services for PLHIV following-up with a stable treatment, are transferred to these sub-district hospitals. “Community-based” refers tothe task shifting of ART services from doctor to nurses in the district hospital, and the delegation of tasks from nurses at the district hospital to nurses and community healthcare workers at the sub-district hospitals.Another characteristic is this model represented the primary level of care with less number of beds for in-patients. In this adapted model, community healthcare workers are trained to provide ART service. Professional nurses provided services previously delivered by a doctor: screening symptoms, and if treatment outcomes were stable, without complications, prescribing ARV drugs as a one-stop service; also an example of the skill mix approach. This was similar to adaptive models of ART services developed in other countries, where nurses and community healthcare workers also collaborated to provide ART services at the local level. This model presented efficient execution of ART services, with quality of care indicated by a low rate of loss to follow up. PLHIV who followed-up without complications to treatment were able to access services close to home, and benefit from community-based care and home visits by healthcare and non-healthcare workers. This reflects a relatively better accessibility to ART servicesin the community-based model of care.

The next model was the doctor-led model operating in Chonburi province, representing a regional level of care. In this model, all PLHIV received ART treatment primarily from a doctor, assisted by other healthcare providers. The management of clinical data was task-shifted from nurses to non-healthcare workers, giving doctors easy and fast reference to the patient data they needed for diagnosis and treatment, and thereby greatly reducing the time they spent delivering ART services. This is a good example of task shifting from healthcare workers to non-healthcare workers for some specific tasks only.

The last model was the mixed-comprehensive model operating in Prachuap Khirikhan province, representing the provincial level of care, where a variety of healthcare professionals and non-healthcare providers delivered ART services as a mixed discipline. This mixed-comprehensive model is also adapted from the Thai national practice guideline for ART services, which recommends that an ART team should include five types of healthcare providers: doctors, nurses, pharmacists and pharmacy technicians, laboratory technicians and non-healthcare providers, in order to deliver a one-stop ART service. This model applies task-shifting in a similar manner to the community-basedmodel. The provision of ART services for PLHIV following-up without treatment complications was shifted from the doctor to a designated pharmacist, with extensive experience of assisting the doctor with the delivery of ART since its introduction. Another workforce strategy adaptation employed in this model, which differed from the community-based and doctor-led models,was the participation of NGO volunteers in the ART team. They carried out many activities not found in the other two models of care: for example, conducting group meetings with patients to monitor their adherence to ARV drugs, and carrying out home visits to encourage patient participation and minimise loss to follow-up. These activities have improved drug adherence and PLHIV retention to ART services. Similar outcomes have been shown in other studies of this model.

To compare the activities, flow of ART services and management in the three models of care (Figure 4.8, 4.9, 4.16 and 4.20): in general, the flow of ART services in each model followed a similar pattern, beginning with registration, followed by symptom screening, diagnosis and treatment. All models had a one-stop-service characteristic and PLHIV did not need to access any other clinics.

Focusing on the task analysis of the three models of care, there were similarities between three of the main ART service activities: ARV drug dispensing, HIV/AIDS and drugs counselling, and laboratory testing. Drug dispensing was carried out by pharmacists and their assistants in different proportions. This study found some differences in the details of some drug dispensing activities among the three models of care. In the mixed-comprehensive models, ARV drugs were pre-packaged. However, in the doctor-led and community-based models of care, there was no pre-packaging. ARV drugs were dispensed as and when needed.

Turning to focus on PLHIV characteristics, most PLHIV receiving ARV drugs had stable treatment outcomes, and consequently, in all three models, most had high CD4 count levels after starting treatment. This indicates that any model of care providing ART services will have an increase in CD4 levels as a treatment outcome, reflecting the effectiveness of the ART services provided by all three models of care (Figures 4.2, 4.12 and 4.17). All achieved good adherence to ARV drugs, leading to a good clinical outcome of treatment, the ultimate goal of ART services.

Focusing on the practice of following-up PLHIV in each model (Figure 4.5 and 4.15), the mixed-comprehensive and community-based models of care had lower rates of loss to follow-up than the doctor-led model, because they both hadvolunteers to visit PLHIV at home, to find out the reasons for any missed appointments without the need for hospitals to employ staff for the purpose. No PLHIV were lost to follow-up, reflecting the advantage of the close communication between healthcare providers and PLHIV in these models of care. The doctor-led model did not have volunteers to reach PLHIV at home. The participation of non-healthcare workers in the community appears to provide benefits and competence to the ART service. This will be further discussed in subsequent sections.

Considering the time required to provide ART services in the three models of care, the community-based model required the mostin following up PLHIV who had no complications from treatment, followed by the doctor-led model; the mixed-comprehensive model required the least (Tables 4.2 ,4.8 and 4.9). However, comparing an average mean of time required to provide ART servicesto all three groups of PLHIV among the three models of care, it was found that the community-based model required the most, followed by the mixed-comprehensive model; the doctor-led model required the least. New cases of PLHIV and those following-up with complications required more time than those following-up without complications. The times each type of provider required to provide ART service tasks varied in each model of care. The findings show that new cases of PLHIV and PLHIV following-up with complications still required more time with a doctor than PLHIV following-up without complications, pharmacists and pharmacy technicians required less time than doctors in all models of care, and non-healthcare providers in all three models required the least time to deliver their registration tasks.

4.8 CONCLUSION

This chapter presented the three different models of care of ART services in three different provinces, representing all four levels of facility in the Thai health sector covering all levels of care provided as a one-stop-service. From the findings, the patterns of ART service deliverycould be categorised into three models: community based, doctor-led and mixed-comprehensive.I conclude that all three adapted their models for delivering ART services, by applying HR strategies; task shifting, skill-mix and the participation of community healthcare and non-healthcare workers, providing services in their own contexts. Each model had similar activities for providing ART services: registry, symptom screening, diagnosis, and drug prescription and dispensing. However, there were differences in detail in each contextl, which distinguished the delivery pattern, as indicated in this chapter.

Descriptive analysis and comparisons of the main aspects (as summarised in Section 4.7 and Table 4.11) of the three models of care suggest only minor variations in the accessibility and quality of ART services, as currently delivered in Thailand, indicated by increases in the CD4 levels of PLHIV after theybegan ART, and the low rate of loss to follow up. Moreover, all three models of care presented an increased rate of accessibility to ART services; the community-based model, delivering ART services at the lowest facility level of care (sub-district hospital), demonstrating the effectiveness of allowing PLHIV to acess ART service close to their homes.

CHAPTER 5

ESTIMATIONS OF HEALTH WORKFORCE REQUIREMENTS:

DEMANDS, GAPS, AND AVAILABILITIES

5.0 INTRODUCTIONS

This chapter presents the main results found in the quantitative stage of my research. Data and information about the time required to provide ART servicesin the three models of care were drawn from Chapter 4 as secondary data, and were applied as input parameters for Markov analysis; uncertainty analysis was undertaken using Monte Carlo simulation, as described in Chapter 3. Estimations and projections of the time required to provide ART services for 2012 to 2025 are included as key findings of this chapters.

Section 5.1evaluates the secondary data addressing the number of PLHIV who have received ART services, and the projection of these figures to 2025; which refers to demand. These sets of data were collected from the national database and related publications, particularly grey literature. Section 5.1.1 illustrates the actual data from the national database, and the projections from the study. Section 5.1.2 presents a documentary database for the data of the supply side. The estimation of availability of healthcare providers of government sectors were presented.

Section 5.2 presents the input parameters for the estimation of the time required to provide ART services, and the demands for, gaps in, and availability of, the health workforce. The time required to provide ART services is analysed in terms of each cadre of healthcare professionals and non-healthcare workers, from semi-structured interviews with the heads of the ART teams, and presented in the finding in Chapter 4. Section 5.2.2 describes the input-parameters for Markov analysis, including the time required to provide ART services per PLHIV per year, and formulae and assumptions to run the Markov model (Section 3.4).

The Markov analysis is explained and applied for an analysis of the time required to provide ART services presented in Section 5.3. Sensitivity analysis, Monte Carlo and uncertainty analysis are used for simulating the results of Markov analysis attained with probability distributions, to ensure that the results were developed using the appropriate tools described in Section 5.4. I also applied the results simulated by Markov and Monte Carlo analysis to estimate the gaps in the health workforce presented as a proportion of the health workforce, compared with the availability of healthcare providers. Section 5.5 presents the conclusion of this chapter.

5.1 NUMBERS OF PLHIV AND HEALTHCARE PROVIDERS COLLECTED FROM SECONDARY DATA SOURCES

The results of the secondary data collection are presented as follows: the number of PLHIV who have received ARV drugs (Thai Working Group on HIV/AIDS 2008), and its future projection; the number of principal healthcare providers delivering ARV drugs.

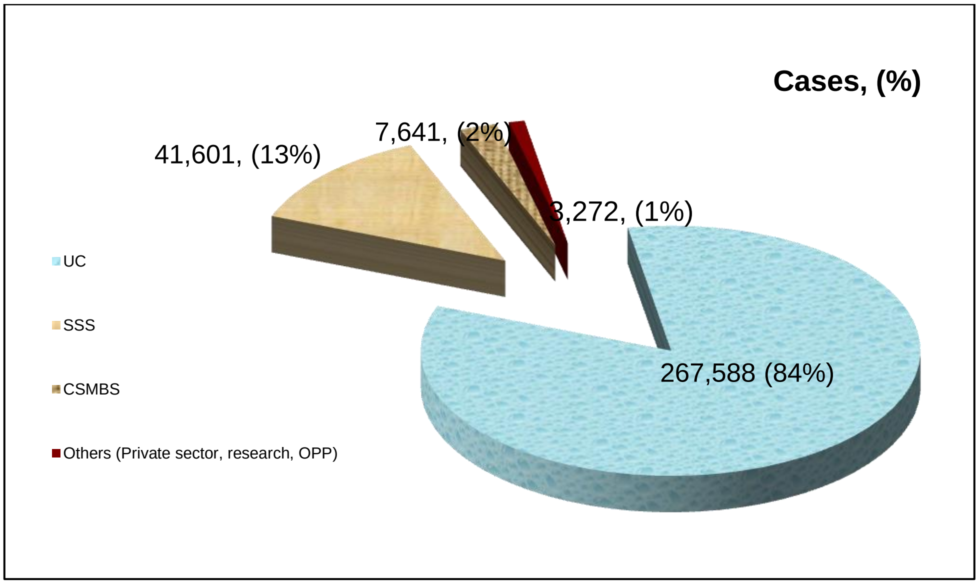
5.1.1 Demand side: estimated numbers of PLHIV registered to access ART services in the Thai healthcare system

A. Numbers of PLHIV registered in the national programme

In 2012, 320,102 PLHIV were registered as accessing the Thai ART service, under three financing schemes, as referred to in Chapter 2 (literature review); (National Health Security Office 2011b; National Health Security Office 2012a; National Health Security Office 2012b). Figure 5.1 shows the number of PLHIV accessing ART services under each benefit scheme in 2012; National Health Insurance Scheme (NHSO), Social Security Scheme (SSS), Civil Servant Medical Beneficiary Scheme (CSMBS) [23] and out of pocket (OPP) which the PLHIV paid themselves.

[23] The National Health Security Office (NHSO) is an institute in charge of universal coverage for the Thai population, covering the 74% of the target population not covered by the other two public schemes: the Civil Servant Medical Beneficiary Scheme (CSMBS), which funds heathcare for government employees (10% of the population) and the Social Security Scheme (SSS) for non-government employees.

Figure 5.1 Number of PLHIV accessing ART services up to 2012



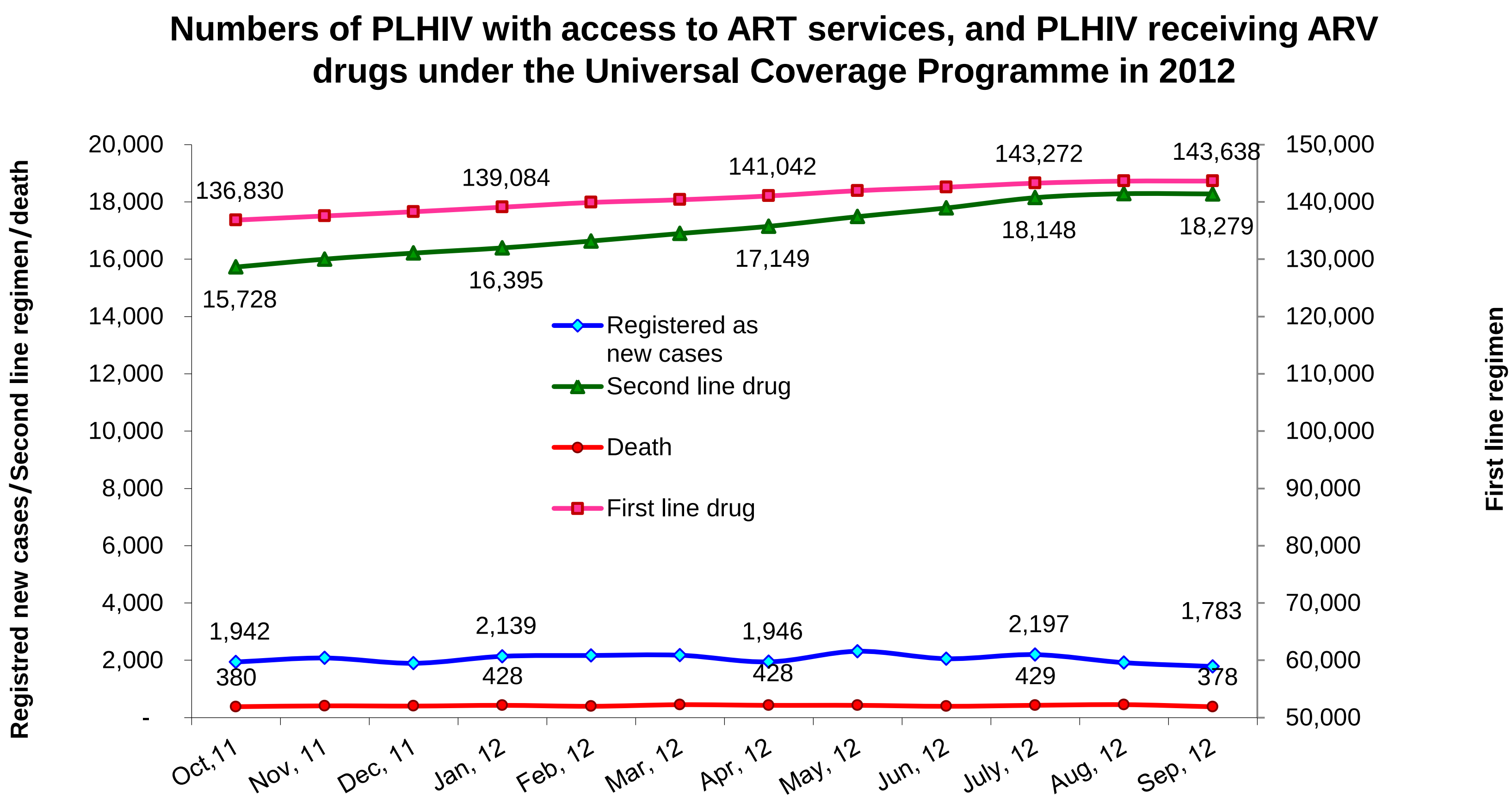
Source: National Health Security Office 2011b; National Health Security Office 2012b

Not all PLHIV who were eligible under the universal coverage programme were receiving ART services (Sungkanuparph et al. 2010). Those with CD4 counts higher than the recommendations of the national guideline (350 cell/mm^3), (Sungkanuparph et al. 2010) were at risk of opportunistic infections which had to be treated before ARV drug treatment could begin; and there could be non-medical reasons such as waiting to have laboratory tests, or receive the results of laboratory tests, or waiting for notice of eligibility to receive ART services under one of the beneficiary schemes.

Figure 5.2 shows the numbers of PLHIV receiving ART services: first-line basic regimen and second-line or advanced regimen. The graph also presents the number of PLHIV who received ARV drugs, but subsequently died. Since October 2012, the NHSO has provided ARV drugs to all PLHIV with a CD4 count lower than 350 cell/mm^3. Previous to this, ARV drugs were only prescribed when CD4 counts were lower than 200 cell/mm^3 (Bureau of AIDS, TB, and STIs 2004). There is an increasing trend of PLHIV accessing ART services and receiving ARV drugs. At the end of the 2012 fiscal year, there were 267,588 PLHIV accessing ART services (of whom 161,917 were receiving ARV drugs) under the Universal Access Scheme, which is funded and managed by the Ministry of Public Health (National Health Security Office 2012b).

The total number of PLHIV (in Thailand) who died after accessing ART services averaged 480 PLHIV per month (National Health Security Office 2012b). Other categories are those of new cases accessing ART services or registering as new cases of HIV (an average of about 2,000 per month). NHSO reported the one-year survival rate as 92.08% of PLHIV on ART. If we consider the admission rate accessing ART services, about 20% of the total number of PLHIV in 2011, this figure should be included and used for projecting the future need for ART services.

Figure 5.2 Numbers of PLHIV receiving first-line or second-line ARV drugs, new cases, and deaths (in Thailand)



Source: Yearly report of the National AIDS program 2012

B. Projections of number of PLHIV in Thailand

In 2001, the Thai Working Group on HIV/AIDS made projections for an epidemic of HIV/AIDS and the consequent number of PLHIV in Thailand, and the figures were revised in 2005. There are limitations in the projection model because it was conducted in the last decade. In 1994, the collaboration of the National Economics and Social Development Board (NESDB) and both Thai and international partners made projections to ascertain the number of HIV infections, cases of AIDS, AIDS related deaths and other key information about HIV/AIDS in Thailand (Thai Working Group on HIV/AIDS Projection 2001). The Working Group used the number of HIV infections, AIDS cases, and AIDS related deaths and age distributions as key variables. They used data collected from sentinel sero-surveillance, sero-prevalence in conscripts, national data of sexually transmitted diseases (STD), surveys of partner relations and the effectiveness of AIDS Media on behaviour and values in 1993, and the evaluation of the 100% Condom Program (Thai Working Group on HIV/AIDS 2008). However, due to significant changes in the epidemiological and behavioural situation, the working groups: the AIDS division of the Ministry of Public Health; the NESDB; UNAIDS and other key stakeholders developed a new model and set of projections in year 2005.

Rationale, criteria and assumptions of the 2005 projection

1. The criteria for asymptomatic PLHIV eligible for ARV was set at aCD4 count of <200 cell/mm^3; they were then moved into one of three treatment arms (public, augmented public or private). 2. After PLHIV had received first-line regimen ARV drugs, there were four possibilities: 1) continue with first-line treatment for the foreseeable future, 2) withdraw from treatment due to side effects of ARV drugs or for other reasons, 3) move from first-line therapy to second-line therapy, or 4) death.

3. The criteria for PLHIV eligible for second-line ART was set at a CD4 count <50 cell/mm^3; patients are also then moved into one of three treatment arms (public, augmented public and private).

4. Details of PLHIV who, while undergoing ART, were considered likely to transmit HIV to others (changes in infectivity associated with ART).

5. Both naïve and resistant virus forms are modeled and tracked.

6. It was assumed that PLHIV who are on ARV drugs will have a lower probability of transmission at 0.25%, which is a 75% reduction in the transmission of HIV.

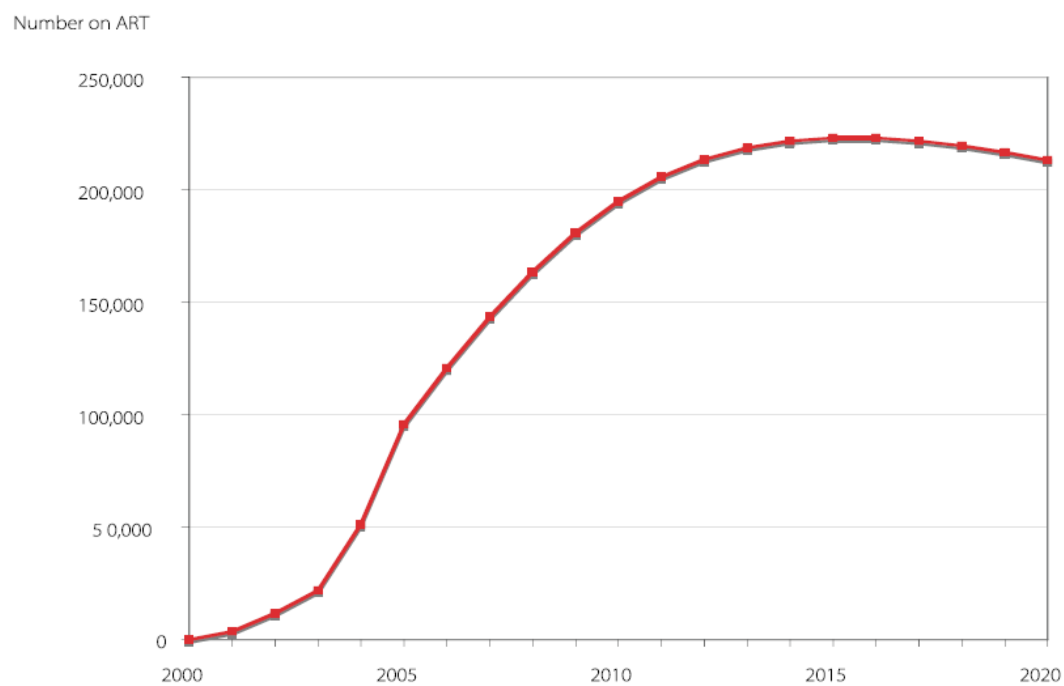
7. The average time for the progression of PLHIV (without ART) from HIV infection to serious AIDS illness is about 9.5 years. The average time from onset of serious illness to death is about 0.9 years, without ART. The average number of years before death for asymptomatic PLHIV with a CD4 count of <200 cell/mm^3 was 2 years, and for symptomatic PLHIV was 0.9 years. The period of HIV infection to death (without treatment) was 10.4 years.

8. The essential demand for ART services was specified as a percentage of PLHIV seeking treatment, who were eligible to start ART, in each treatment arm, and the percentage of these who met the symptomatic or asymptomatic criteria for ART.

9. The number of facilities providing ART services would grow by 1.5 % per year

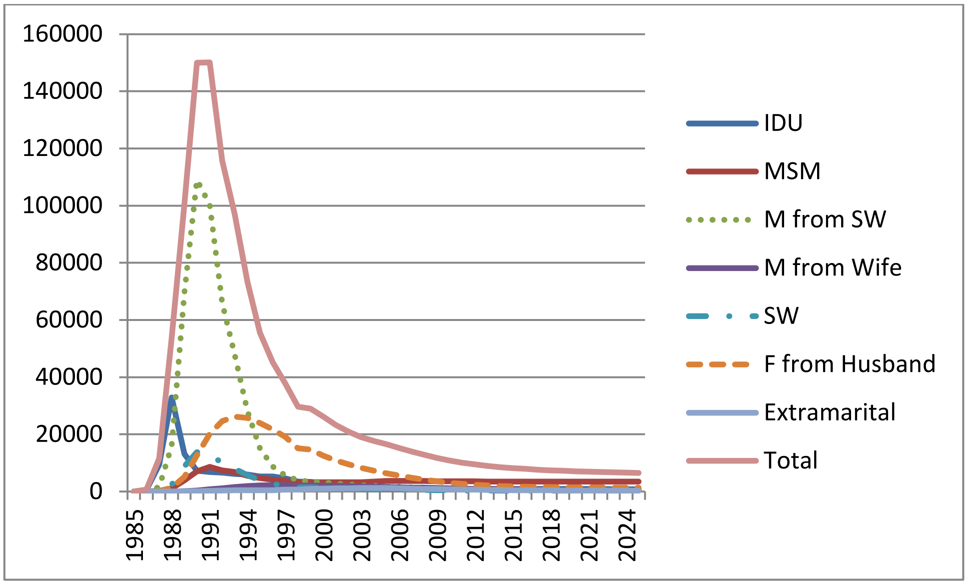
10. The number of PLHIV receiving ARV drugs grew rapidly, stabilising at over 200,000 after 2010. The percentage to access ARV services before becoming symptomatic was assumed to increase from 3% in 2005 to 10% in 2020 (Figure 5.3).

Figure 5.3 Number of PLHIV accessing ART services each year in projection



Source: The Working Group on HIV/AIDS Projection 2008

Figure 5.4 Numbers of new infections among adults by mode of transmission

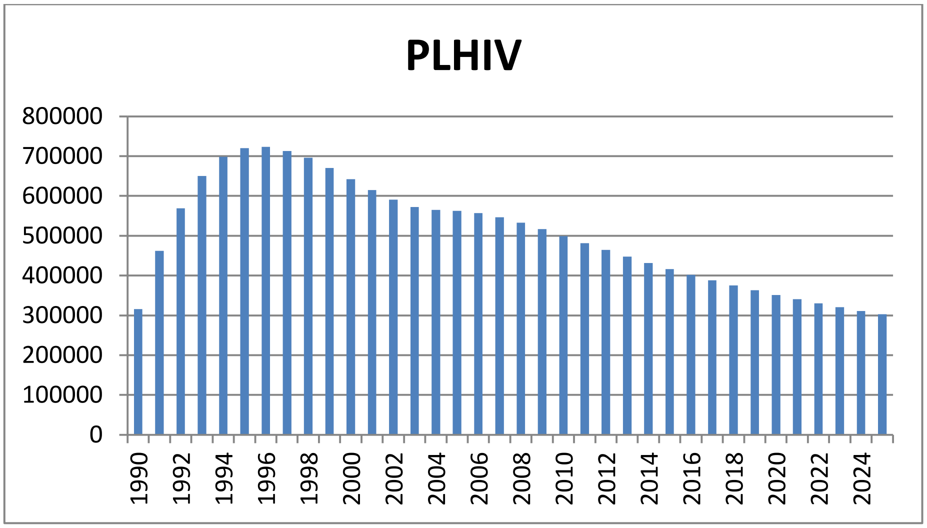


Source: The Working Group on HIV/AIDS Projection 2008

Note: IDU refers to injecting drug user, MSM refers to men who have sexual intercourse with men, M refers to male gender, SW refers to sex worker, F refers to female gender.

In Thailand, HIV epidemics have changed over time, moving through the various risk-groups in the population. In the previous two decades, the infection appeared first among sex workers, reaching a peak of over 25,000 people in early 1985. This was followed by men who had contracted the infection from sex workers, which reached its highest level at over 100,000 in 1990, since when it has continuously declined. In the last decade, the epidemic has most affected females infected by their husbands; peaked later than 1991. There is an increasing trend of new infection among men who have sex with men (MSM). However, from the projection (Figure 5.5), no groups show an increase in numbers of new infections since 1991 (Thai Working Group on HIV/AIDS 2008).

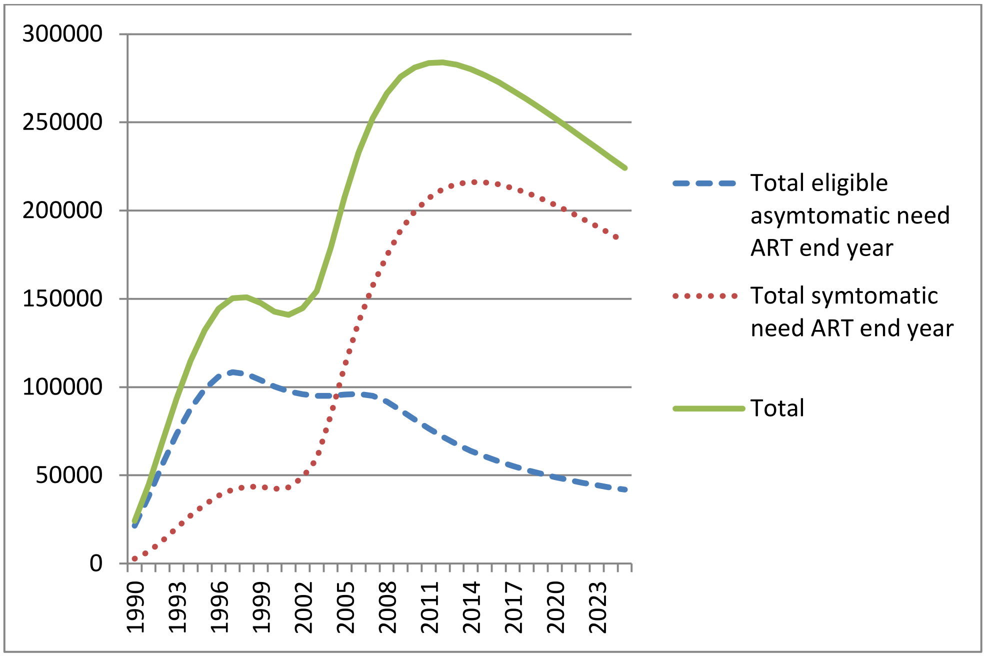
Figure 5.5 Numbers of PLHIV (1990 to 2025)



Source: The Working Group on HIV/AIDS Projection 2008

The Thai Working Group on HIV/AIDS Projection estimated the number of PLHIV in 2005 owing to the effect of prevention programmes, which have implemented condom promotion, public information and targeted education. These prevention programmes succeeded in resisting the HIV epidemic. The number of new infections has declined dramatically since the end of the first decade of the century (Figure 5.5).

Figure 5.6 Numbers of PLHIV need ART (1990 to 2025)



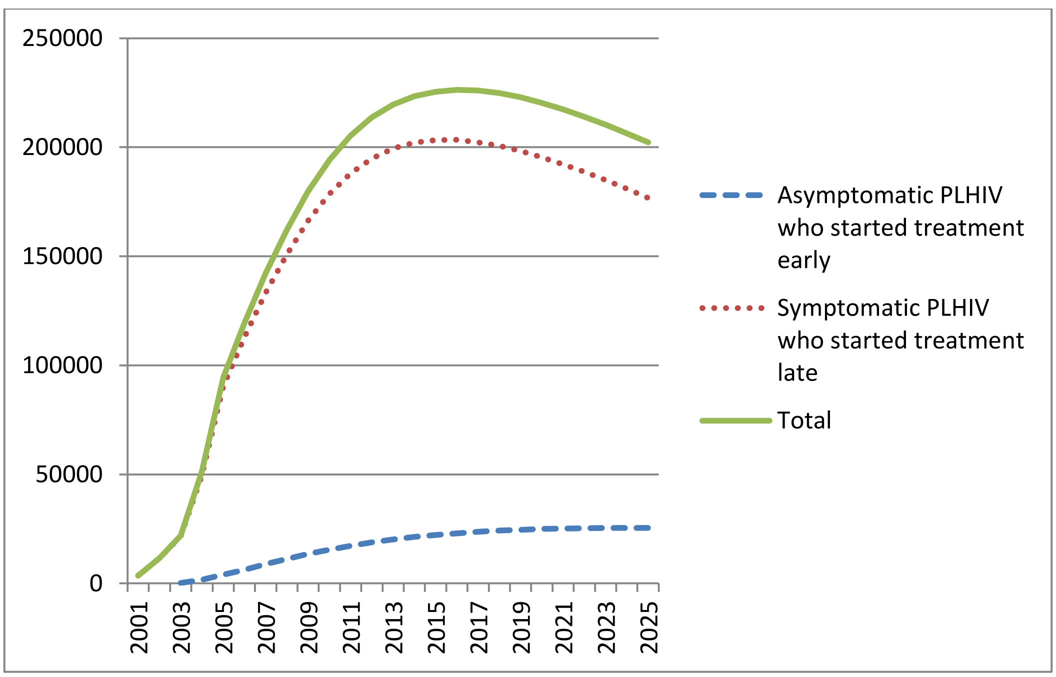
Source: The Working Group on HIV/AIDS Projection 2008

The projection of the number of PLHIV categorised as asymptomatic and symptomatic, who will need ART, shows the demand on the ART service. Figure 5.6 shows the projected number of PLHIV needing ART services. The projection shows an increasing trend of symptomatic PLHIV, whereas the numbers in the asymptomatic group show a decreasing trend.

From the information in this projection, one published article infers that Thailand will need to provide ARV drugs for 285,000 PLHIV in 2015; but different groups of PLHIV will require treatment according to their particular needs.

The Working Group estimated the number of PLHIV who received ART, from among the total number of PLHIV, Figure 5.7. The line chart shows clearly that most PLHIV started ART at a late stage of their infection, when they were already symptomatic (usually having CD4 count < 200 cell/mm^3); fewer than 25,000 PLHIV started ART at an early stage (CD4 count $\geq$ 200 cell/mm^3).

Figure 5.7 Projected numbers of two groups of PLHIV: the asymptomatic who started ART early and the symptomatic, who started late (2001 to 2025)

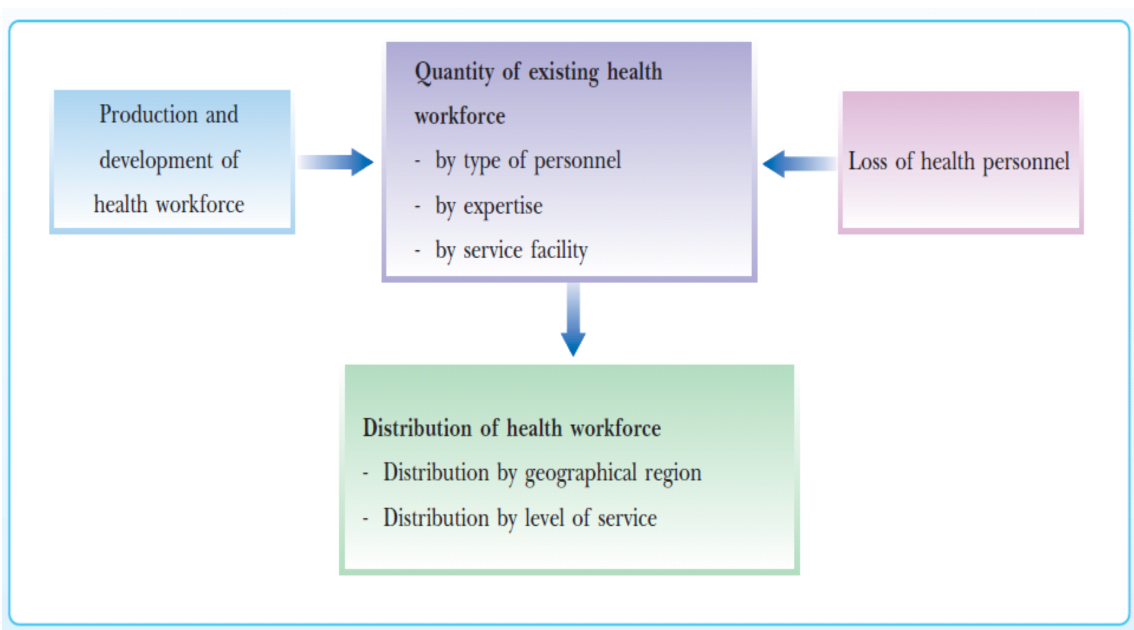


Source: The Working Group on HIV/AIDS Projection 2008

5.1.2 Supply side: *national data of the number of health care providers, and other available sources of healthcare*

Analysis of the Thai health workforce indicates four aspects: production and development; the numbers of the existing workforce; distribution; and loss (Figure 5.8), (Ministry of Public Health 2010b). Among these four, my study related to to the projection of health workforce data and its simulation, which will be indicated in the next section as the parameters of Markov model analysis. The existing numbers of the health workforce were also needed in the calculation of the estimation for the health workforce requirement, as found in the literature review (Hall and Mejia 1978; Hornby 1980). Moreover, distribution and loss were also important to be considered in the HRP issue for the estimation of my study.

Figure 5.8 Aspects in the analysis of the health workforce situation



Source: Thailand health profile (Ministry of Public Health 2010b)

As reviewed in Chapter 2, there was a need to bring all four aspects into consideration. The four studies that were reviewed and included in the data analysis in Section A of this section explained that they involved for all four aspect in the analyses of the health workforce situation (Suwannakij et al. 1998; Suphanchaimat et al. 2013), nurses (Srisuphan et al. 1998) and pharmacists (Payanantana et al. 1998).

My study applied the projected numbers in the main cadres with other related parameters, to be analysed to elicitgaps existing between the requirement and the availability of healthcare workers. The Thailand health profile reported numbers of health personnel in 2009; however, this data is inaccurate because incomplete (Ministry of Public Health 2010b). Other possible data sources are databases and reports which were published in the Thai language and journals hosted by Thailand, and published in English. The four principal articles that this study could find for data of the supply side were for the main healthcare providers: doctors (Suwannakij et al. 1998; Suphanchaimat et al. 2013), nurses (Srisuphan et al. 1998) and pharmacists (Payanantana et al. 1998).

A: Supply of physicians

The report of the Thailand Health profile, using data from the health resource survey (Ministry of Public Health; MOPH) may be inaccurate because it is incomplete. It reported that 35,789 physician doctors were practising in Thailand in 2009. The other two articles reported different numbers: 38,217 (Suwannakij et al. 1998) and 32,539 (Suphanchaimat et al. 2013). These articles and the Thailand health profile (Ministry of Public Health 2008), projected the number of physicians based on the three types of projection tools available; cohort, observed change and two life-table method.

The updated article of 2013 applied the cohort method and used the health workforce loss-rate, applied in the supply projections, which included both cohort and life-table approaches.

Information about the number of licensed physicians practising between 1997 and 2010 was obtained from the Thai Medical Council, which claimed that records were unique to each physician, with no possibility of counting the same person twice; however, the data sets did not reflect active service, and included doctors who may have died but had not been removed from the register. Data sets from two other Medical Council surveys from 2010 and 2011 were also used, which reported 37,396 and 39,269 physicians as contactable. Suphanchaimat et al (2013), assuming that any doctors aged over 70 were no longer practising, and that 44% of doctors aged between 60 and 70 were practising, calculated the number of practising doctors as 83% of the previously quoted figure for 2010 and 2011.

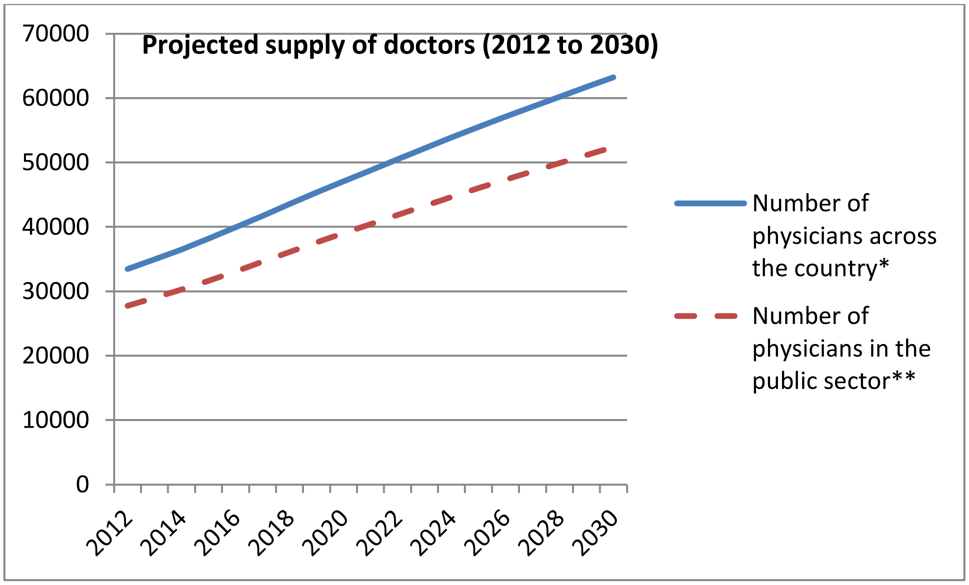
Focusing on an assumption of annual loss rate, the latest study claimed that the 0.45 % of loss rate reported by studyof Srisuphan et al (1998) was too low. A loss rate of 1% best fitted the number of active physicians in 2010 and 2011, and this rate was used for projecting from 2012 to 2030 (Suphanchaimat et al 2013).

Accurate figures for the number of current physicians were needed to project the supply of physicians in the future. In 2010, approximately 1,800 graduates gained licences in public medical schools. Three significant and rapid changes in the training and licensing of doctors are likely to impact on the future supply of physicians. Firstly, an expansion of medical schools from 13 to 18 over the past 15 years (1996 to 2010); secondly, the one private medical school in the country tripled its output from 30 doctors in 1999 to 93 doctors in 2010; and lastly, the number of licensed doctors from foreign institutions averaged an increasing trend of 15 per annum (Suphanchaimat et al 2013).

Some details in the updated study indicated that there was a significant decrease in numbers of new doctors in 2010. The updated study (Suphanchaimat et al. 2013) projected numbers of graduates from 2012 to 2030, estimating that there would be more than 2,500 per year from 2017 onwards; this represents a sizeable increase (4.32%) to the figure of 1,745 per year from 2011 to 2020, projected by the last study in 1998 (Suwannakij et al. 1998).

My study estimated and projected the numbers of physicians in the future, as indicated in the previous paragraphs assuming retention at 99%. However, my study focuses only on the public sector. The Thailand Health Profile report illustrated the proportions of physician doctors active in the public and private sectors, the public sector showing a decreasing trend, from 93.2 % of the total in 1971 to 82.9 % in 2009 (Ministry of Public Health 2010b); I used the 2012 data for the following calculations. Figure 5.9 shows figures for the number of physicians utilised in estimating the supply of physicians available to the public sector from 2012 to 2030. I used 82.9% as the percentage of physicians working in public hospitals, because my study aims to investigate and project only for the public sector, as most PLHIV are registered and accessed to the ART service in public services (90% of total number of PLHIV as presented in figure 5.1), (National Health Security Office 2010b; Ministry of Public Health 2010b) to calculate the number of physicians in the public sector from 2012 to 2030. This may be a limitation of this study because the 82.9% was applied to year 2030; this may not apply in the future; however, I had to use as the data was available. For the reason that this study did not focus on the private sector or the dual employment, was because a limitation of access to the data and information of either supply and demand side of the private sectors, as well as the PLHIV in the private sector, was assumed to be a small number, less than 10% of total number of PLHIV (Figure 5.1, National Health Security Office 2012b).

Figure 5.9 Projected supply of doctors (2012 to 2030)



Note: * Data from the study in 2013 (Suphanchaimat et al. 2013)

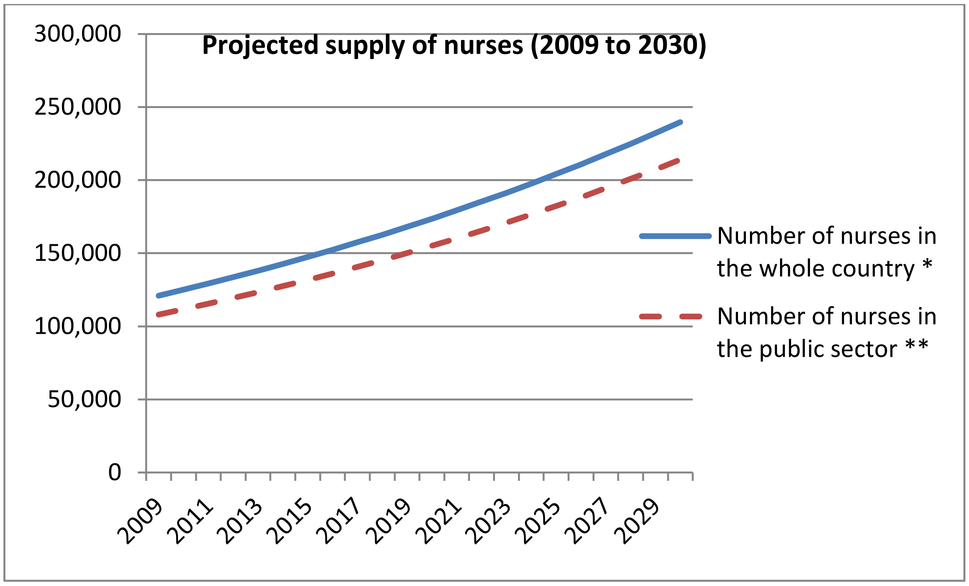
** Apply 82.90 % as the numbers of the physicians in public hospitals (Ministry of Public Health 2010b)

B: Supply of nurses

During data collection, two studies emerged, presenting figures of the numbers of available nurses. The Thailand Health profile (Ministry of Public Health 2010b) stated that in 2009, there were 120,948 professional and registered nurses actually working in the country. The study of supply and the projection for 1995 to 2015 estimated that 120,859 nurses would be available (Srisuphan et al. 1998), with the medium loss rate assumption at 3.14%. This study is based on the plan for the training of nurses by the Nursing Academic Institute, under the Ministry of University Affairs for all Ministries. The projection was calculated from the existing number of nurses, plus the number of new graduates, and minus the annual loss rate.

Srisuphan et al (1998) claimed that a previous study in 1969 had predicted a high loss-rate: 8.23% (Office of National Educational Council 1969), but in fact, the loss rate had continuously decreased. A 1989 study reported loss rates of 5.8% from 1976-1985, 4.69% from 1986-1990 (Charoenyuth 1989), and 3.14% in 1993 (Charoenyuth 1994). The 1998 study estimated the loss-rate to be 1.5% for the twenty year period of projection; they also proposed a medium loss-rate of 3.14% and a high loss-rate of 5%. I selected 3.14% as a choice for a medium rate for calculation, since there is no consensus for this. Then, taking the number of nurses in 2009 as 120,948, as reported by the Nursing Council in the Thailand Health Profile (Ministry of Public Health 2010b), I multiplied this figure by 89.30% to estimate the number of nurses in the public sector. The figure of 9,025 nursing graduates per year was taken from the 1998 study (Figure 5.10), (Srisuphan et al. 1998).

Figure 5.10 Projected supply of nurses (2009 to 2030)



Note: * Data from Thailand Health profile (Ministry of Public Health 2010b)

** Apply 89.30% as the numbers of the nurses in public hospitals (Ministry of Public Health 2010b)

C: Supply of pharmacists and pharmacist technician

Data from the Pharmacy Council, in the Thailand Health profile (Ministry of Public Health 2010b) reported 24,401 pharmacists (Ministry of Public Health 2010b) living in the country in 2009, but the health resource survey reported only 7,698; reflecting the inaccuracy and incompleteness of the data. However, the 1998 study reported the existing numbers of pharmacists (Ministry of Public Health 2010b) and estimated their numbers for the two decades of 1995 to 2015.

The Thailand health profile reported that about 50% of pharmacists worked for the private sector (drug manufacturers, import companies and drugstores, etc) between 1971 and 1985. However, the government launched compulsory work in the public sector for newly graduated pharmacists between 1984 and 2006. This policy raised the percentage of pharmacists working in the public sector (especially the Ministry of Public Health) to 73.40 % by 2009.

The 1998 study, projected the future numbers of human resources in pharmacy and health consumer protection services in Thailand from 1995 to 2015, researchers and experienced pharmacists from each branch of pharmacy (hospital, community, industrial, marketing, public health consumer protection and educational) brainstormed in order to determine future trends of supply and demand.

The future supply was estimated from the training plan, predicted graduation rate and annual loss-rate.The researchers then met with multi-stakeholders for re-examination and re-adjustment of the forecasts and finally published the result. They proposed that stable conditions would lead to an annual loss-rate of 3-4 %, compatible with a working life of 25-33 years (Payanantana et al. 1998).

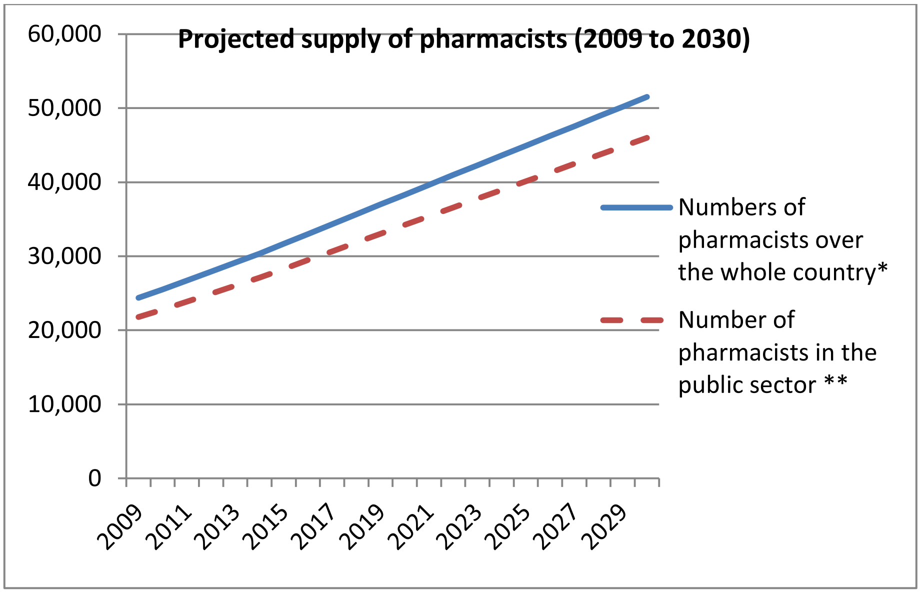
The Pharmacy Council provided data to the Thailand health profile, stating that there were 24,401 pharmacists in 2009. The 1998 study estimated numbers of pharmacists in 2009 to be 19,624 and 18,747, with two assumptions of different loss rates; 1.00 % and 1.50 %, respectively (Table 5.3). These figures of actual numberswere much lower than the updated figure in the Thailand Health profile in 2010. In my study, I used 24,401 as the number of pharmacists from the Thailand Health Profile, as they have more records of the number of pharmacists, and I applied the figures for the numbers of student enrolment and graduates (96%), (Payanantana et al. 1998). The study presented in the study in 1998 with the lower loss-rate as 1% that they used for calculation. If I applied 1.5 the projected number of pharmacists even further than the record from the Thailand health profile. I calculated the numbers of pharmacists working only in the public sector, using the data from the Thailand Health Profile: 73.40% multiplied by the estimated numbers of pharmacists, presented in Figure 5.11.

Table 5.1 Assumptions and estimated numbers to project the future supply of pharmacists (2009 to 2015)

Year	Existing pharmacist	Student enrolment	Graduates (96%)	Losses (1%)
2009	24,401	1,170	1,123	244
2010	25,500	1,290	1,238	255
2011	26,712	1,290	1,238	267
2012	27,923	1,290	1,238	279
2013	29,133	1,290	1,238	291
2014	30,342	1,290	1,238	303
2015	31,675	1,420	1,363	317

Note: * Data from Payanantana et al. 1998

Figure 5.11 Projected supply of pharmacists (2009 to 2030)



Note: * Data from Thailand Health profile (Ministry of Public Health 2010b)

** Apply 73.40 % as the numbers of the pharmacists in public hospitals (Ministry of Public Health 2010b)

For an estimation of the number of pharmacy technicians, I retrieved information from secondary data sources; an estimation of pharmacy technician requirements at 5-yearly intervals from 1995 to 2015 (Payanantana et al. 1998). Table 5.2 shows estimations of the appropriate ratio of pharmacists and pharmacy technicians, and their required numbers. I could not obtain data on the number of pharmacy technicians; so used information from the 1998 study as mentioned above, with the ratio of pharmacist to pharmacy technician at 1: 1.

Table 5.2 Estimations of appropriate ratio of pharmacists to pharmacy technicians and their requirements (1995 to 2015)

Year	Appropriate ratio of Pharmacist : Pharmacy technician	Required numbers of pharmacy technicians
1995	1:2	17,128 - 18,248
2000	1:1.75	16,457 - 17,437
2005	1:1.5	15,450 - 16,290
2010	1:1.25	14,063 – 14,763
2015	1:1	12,260 – 12,820

Note: The ratio of pharmacist to pharmacy technician is 1: 1 (Payanantana et al. 1998)

To sum up, this section mainly provided the estimated number of PLHIV and healthcare providers. The data were collected from secondary data sources including national reports and literature hosted by Thailand. Estimated numbers that were used in my study were applied from various sources of data, as presented in this section, to be used as inputs for the estimation/simulations by Markov and Monte Carlo analysis, with other inputs of time required to provide ART services of each type of healthcare provider, which are presented in the next section.

5.2 TIME REQUIRED TO PROVIDE ART SERVICES IN DIFFERENT MODELS OF CARE

A. Time required to provide ART services by healthcare provider, categorised by three different states of health and treatment of PLHIV

The times required to provide ART services in the three different models of care were applied for Markov model analysis. The times, in minutes, were analysed in Chapter 4 with Kolmogorov-Smirnov and Shapiro-Wilk, for testing normal distribution, and non-parametric tests, and with an independent sample Kruskal Wallis test at P-value $\leq$ 0.05.

The times required to provide ART services in the three differentmodels of care were applied for Markov model analysis. Table 5.3 presents the results for three different groups of PLHIV in three different states of health and treatment: follow-up without complications, with complications, and new cases.

Table 5.3 shows that doctor-led model required the least time to provide ART service, significantly, (P-value <0.05); the community-based model required the most. PLHIV following up with complication required time the most, following up without complication reuired the least.

Table 5.3 Time required to provide ART services per visit in the three different models of care, to three groups of PLHIV defined by states of health and treatment

Health-stages of ART treatment	Numbers of PLHIV	Time required for healthcare providers to deliver ART services (in minutes)		
		Community-based model	Doctor-led model	Mixed-skill and comprehensive model
Number of PLHIV (cases)	**Total** 1,526	307	984	235
Follow-up without complications	1,374	8.24 ± 0.18	6.11 ± 1.97 *	6.09 ± 0.14*
Follow-up with complications	122	10.23 ± 0.60*	11.05 ± 3.84	12.75 ± 0.10
New cases	30	9.78 ± 2.11	11.14 ± 2.98	13.35 ± 1.23
Average of time required for healthcare providers to deliver ART services		**8.47 ± 3.08#**	**6.54 ± 2.58#**	**7.00 ± 3.39#**

Note: * Significant difference compared within the same model of care
Significant difference compared among different models of care

B. Time required by each model of healthcare provider to provide ART services per PLHIV per visit

Table 5.4 presents the task allocations among healthcare providers in each model of care, for each group of PLHIV: new cases (Table 5.4A), following-up without complications (Table 5.4 B), and following-up with complications (Table 5.4C). Task analysis of ART services was conducted from observation, structured and open-ended interview, as presented inChapter 4.

Table 5.5 presents the time required to provide ART services by healthcare providers in each model of care, for each group of PLHIV: new cases (Table 5.5A), following-up without complications (Table 5.5B) and following-up with complications (Table 5.5C). The means of time required to provide each activity of ART services present the time required per visit.

For PLHIV following-up without complications, the three models of ART services assigned task allocations differently. In Model 1 (community-based) and Model 3 (mixed-comprehensive), doctors delegated all diagnostic tasks to other professionals: nurses in Model 1 and designated pharmacist in Model 3. In the doctor-led model, all diagnosis was carried out by the doctor. All models of care used non-healthcare workers to deliver registration services. The other main activity, of ART, drug delivery was provided by the pharmacy team

The time required to provide each ART service task are the task's distribution is a mean of time required per visit analysed by SPSS statistical analysis collected from observations in the filed work study (Table 5.5)

Table 5.4 Task allocations in each model of care for each group of PLHIV

Table 5.4A Task allocations which were distributed as percentage of each type of healthcare provider for **new cases**

For new cases of ART, the team provided ART services with similar task allocations and activities as those provided for PLHIV following-up with complications.

Tasks	Model 1 (task, %)					Model 2 (task, %)					Model 3 (task, %)					
	Doctor	Nurse	Pharma-cist	Pharmacy Technician	Non-health	Doctor	Nurse	Pharma-cist	Pharmacy Technician	Non health	Doctor	Nurse	Pharma-cist	Pharmacy Technician	Non-health	Task shift from doctor to designated pharmacist
Diagnosis	100	-	-	-	-	100	-	-	-	-	100	-	-	-	-	-
Registration	-	-	-	-	100	-	-	-	-	100	-	-	-	-	100	-
Drug delivery	-	-	70	30	-	-	-	50	50	-	-	-	50	50	-	-

Table 5.4B Task allocations which were distributed as percentage of each category of provider for **PLHIV following-up without complications**

Tasks	Model 1 (task, %)					Model 2 (task, %)					Model 3 (task, %)					
	Doctor	Nurse	Pharma-cist	Pharmacy Technician	Non-Healthcare provider	Doctor	Nurse	Pharma-cist	Pharmacy Technician	Non-Health-care provider	Doctor	Nurse	Pharma-cist	Pharmacy Technician	Non-Health-care provider	Task shift from doctor to dediacted pharmacist
Diagnosis	-	100	-	-	-	100	-	-	-	-	-	-	-	-	-	100
Registration	-	-	-	-	100	-	-	-	-	100	-	-	-	-	100	-
Drug delivery	-	-	70	30	-	-	-	50	50	-	-	-	50	50	-	-

Table 5.4C Task allocations which were distributed as percentage among of models of providers for **PLHIV following-up with complications**

Tasks	Model 1 (task, %)					Model 2 (task, %)					Model 3 (task, %)					
	Doctor	Nurse	Pharma-cist	Pharmacy Technician	Non-Healthcare provider	Doctor	Nurse	Pharma-cist	Pharmacy Technician	Non-Health-care provider	Doctor	Nurse	Pharma-cist	Pharmacy Technician	Non-Health-care provider	Task shift from doctor to dedicated pharmacist
Diagnosis	100	-	-	-	-	100	-	-	-	-	100	-	-	-	-	-
Registration	-	-	-	-	100	-	-	-	-	100	-	-	-	-	100	-
Drug delivery	-	-	70	30	-	-	-	50	50	-	-	-	50	50	-	-

Table 5.5 Mean of time required (in minutes, per PLHIV, per visit) for each model of provider to provide ART services to each group of PLHIV

Table 5.5A Mean of time required (in minutes, per PLHIV, per visit) for each model of care to deliver ART services to **new cases**

Tasks	Model 1 (task, %)					Model 2 (task, %)					Model 3 (task, %)					
	Doctor	Nurse	Pharma-cist	Pharmacy Technician	Non-Healthcare provider	Doctor	Nurse	Pharma-cist	Pharmacy Technician	Non-Health-care provider	Doctor	Nurse	Pharma-cist	Pharmacy Technician	Non-Health-care provider	Task shift from doctor to dedicated pharma-cist
Diagnosis	6.00	-	-	-	-	5.79	-	-	-	-	10.15	-	-	-	-	-
Registration	-	-	-	-	2.00	-	-	-	-	1.07	-	-	-	-	1.08	-
Drug delivery	-	-	1.24	0.53	-	-	-	2.15	2.15	-	-	-	1.06	1.06	-	-

Table 5.5B Mean of time required (in minutes, per PLHIV, per visit) by each model of care to deliver ART services to **PLHIV following-up without complications**

Tasks	Model 1 (task, %)					Model 2 (task, %)					Model 3 (task, %)					
	Doctor	Nurse	Pharma-cist	Pharmacy Technician	Non-Healthcare provider	Doctor	Nurse	Pharma-cist	Pharmacy Technician	Non-Health-care provider	Doctor	Nurse	Pharma-cist	Pharmacy Technician	Non-Health-care provider	Task shift from doctor to dedicated pharma-cist
Diagnosis	-	3.84	-	-	-	2.41	-	-	-	-	-	-	-	-	-	2.94
Registration	-	-	-	-	1.86	-	-	-	-	1.06	-	-	-	-	1.01	-
Drug delivery	-	-	1.85	0.76	-	-	-	1.32	1.32	-	-	-	1.07	1.07	-	-

Note: *nurses and pharmacists from model 1 and model 3 were specifically delegated by the doctor to provide ART services for PLHIV without complications

Table 5.5C Mean of time required (in minutes, per PLHIV, per visit) by each model of provider to deliver ART services to PLHIV following-up with complications

Tasks	**Model 1 (task, %)**					**Model 2 (task, %)**					**Model 3 (task, %)**					
	Doctor	Nurse	Pharma-cist	Pharmacy Technician	Non-Healthcare provider	Doctor	Nurse	Pharma-cist	Pharmacy Technician	Non Health-care provider	Doctor	Nurse	Pharma-cist	Pharmacy Technician	Non-Health-care provider	Task shift from doctor to dedicated pharma-cist
Diagnosis	5.79	-	-	-	-	6.76	-	-	-	-	9.00	-	-	-	-	-
Registration	-	-	-	-	1.82	-	-	-	-	1.08	-	-	-	-	1.00	-
Drug delivery	-	-	1.83	0.79	-	-	-	1.6	1.6	-	-	-	1.38	1.38	-	-

This section of Table 5.4 – 5.5 presented the time required to provide ART services of each type of healthcare provider, to be used as input for estimations of FTE required for the future. All three models required different time to provide ART service in overall. However, in some activities of ART service were different in means of time required. The data from Section 5.1 and 5.2 were indicated as parameters that were presented in the next section in order to be used for the projection of FTE required of healthcare providers by the Markov and Monte Carlo analyses.

5.3 MARKOV MODEL ANALYSIS OF TIME REQUIRED BY HEALTHCARE PROVIDERS TO DELIVER ART SERVICES

5.3.1 Input parameters for Markov analysis

When PLHIV begin to receive ARV drugs, they are defined as a new case. After commencing treatment with ART service, they become PLHIV who is followed up; it is assumed they will follow-up without complications, with its transitional probability. PLHIV who followed-up without complications in the first cycle came to follow-up for the second cycle and the next cycle, and so on. There are three possible states for PLHIV follow-up in each cycle; 1) follow-up without complications (No com), 2) follow-up with complications (Com) and 3) AIDS related death (Die).

PLHIV following-up at the ART clinic quarterly; the cycle is given at 0.25. The follow-up period of time is every three months, following the national guidelines of ART, in cases with no complications or adverse ARV drug reactions (Bureau of AIDS, TB, and STIs 2004).

This study uses the value 0.083 (1/12)[24] to be input of cycle to calculate when PLHIV pass through their transitional states as cycle-length per month and the model for a life expectancy of 100 years: 99 cycles starting from 15 years old. Then the last age of following up would be 85 years. However, when the result of time required to provider ART service for PLHIV were selected to present, the results were selected from each quarter as the PLHIV visit to be followed up at the hospital (in every three months). The results of the Markov analysis of time required to provide the ART service were collected when the results are in the cycle as quarterly; 0.25, 0.50, 0.75, 1.00, and so on, until all PLHIV were reported in the calculation of the Markov analysis in the die state as the result of time required to provide the service is 0.

To apply the Markov analysis, three kinds of parameters were indicated and used. The first one is the Gamma distribution. In this study, it is the parameter distributions of mean and standard errors which can be any value from zero to infinity. In this study Gamma distribution is the mean of time required to provide ART services by each cadres of healthcare provider.

Table 5.6 presents the mean and standard errors of the time required by healthcare providers in each model of care to provide ART services per PLHIV per visit.

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[24] The 0.083 refers to the ratio of one cycle of the Markov chain which is equal to 1 month. Then ithere is 12 months in a year the cycle- length is 1 devided by 12 which is equal to 0.083.

Table 5.6 Input-parameters of the mean of time required to provide the main activities of ART services.

Healthcare provider/worker	Mean of time required (minutes per visit)	SE	Parameter distribution
Doctor			
Time No comp Model 1	0	0	Gamma
Time Comp Model 1	5.79	0.49	Gamma
Time New Model 1	6.00	1.00	Gamma
Time No comp Model 2	2.41	0.05	Gamma
Time Comp Model 2	6.76	0.43	Gamma
Time New Model 2	5.79	0.65	Gamma
Time No comp Model 3	0	0	Gamma
Time Comp Model 3	9.00	0.96	Gamma
Time New Model 3	10.15	1.18	Gamma
Pharmacist			
Time No comp Model 1	1.85	0.15	Gamma
Time Comp Model 1	1.83	0.46	Gamma
Time New Model 1	1.24	0.11	Gamma
Time No comp Model 2	1.32	0.03	Gamma
Time Comp Model 2	1.60	0.13	Gamma
Time New Model 2	2.15	0.20	Gamma
Time No comp Model 3	1.07	0.05	Gamma
Time Comp Model 3	1.38	0.25	Gamma
Time New Model 3	1.06	0.32	Gamma
Pharmacy technician			
Time No comp Model 1	0.76	0.15	Gamma
Time Comp Model 1	0.79	0.46	Gamma
Time New Model 1	0.53	0.11	Gamma
Time No comp Model 2	1.32	0.03	Gamma
Time Comp Model 2	1.60	0.13	Gamma
Time New Model 2	2.15	0.20	Gamma
Time No comp Model 3	1.07	0.05	Gamma
Time Comp Model 3	1.38	0.25	Gamma
Time New Model 3	1.06	0.32	Gamma
Non-healthcare worker			
Time No comp Model 1	1.86	0.04	Gamma
Time Comp Model 1	1.82	0.10	Gamma
Time New Model 1	2.00	1.00	Gamma
Time No comp Model 2	1.06	0.01	Gamma
Time Comp Model 2	1.08	0.03	Gamma
Time New Model 2	1.07	0.71	Gamma
Time No comp Model 3	1.01	0.01	Gamma
Time Comp Model 3	1.00	0.11	Gamma
Time New Model 3	1.08	0.08	Gamma
Task shifting for nurses in model 1 and for designated pharmacist in model 3			
Time No comp Model 1	3.84	0.11	Gamma
Time Comp Model 1	0	0	Gamma
Time New Model 1	0	0	Gamma
Time No comp Model 2	0	0	Gamma
Time Comp Model 2	0	0	Gamma
Time New Model 2	0	0	Gamma
Time No comp Model 3	2.94	0.12	Gamma
Time Comp Model 3	0	0	Gamma
Time New Model 3	0	0	Gamma

The other two parameter distributions are Alpha and Beta. These parameters do not include those of new cases, which were used separately to calculate the FTE required to provide ART services, and then added to the FTE required to treat PLHIV following-up with and without complication. This was because PLHIV are only in the new-case category once.

Alpha parameters refer to health status events. In this study, the Alpha parameters represent three kinds of such events, as follows:

1) Alpha distribution represents the numbers of PLHIV with the health status event of following up without complications, but with the possibility of complications (no-comp to comp).

2) Alpha distribution represents the numbers of PLHIV with the health status event of following up with complications, with the possibility of moving to non-complication (comp to no-comp).

3) Alpha distribution represents the numbers of PLHIV with the health status event of following up with complications to death (comp to death).

Beta parameter is the other health state that is the total number of PLHIV excludingan event (Alpha parameter). There are three types of Beta in this study;

1) Beta represents an event comprising the total number of PLHIV excluding the event of PLHIV following-up without complications with the possibility of complications (no-comp to comp).

2) Beta represents an event comprising the total number of PLHIV excluding the event of PLHIV following-up with complications, with the possibility of moving to non-complication (comp to no-comp).

3) Beta represents an event comprising the total number of PLHIV excluding the event of PLHIV with complications dying of an HIV/AIDS related illness while receiving ARV drugs (comp to death).

Table 5.7 presents the events (Alpha parameters) and total numbers of PLHIV (from observations in the field work study) and excluded events (Beta parameters). New cases were excluded from the total number in this stage of the calculation, because the they are only in this category for one visit, after which they become PLHIV following-up without complication, where they can either remain, or change to following up with complications.

The time required to provide ART services to new cases was included in the model after the Markov analysis for PLHIV following-up with and without complications. The events of PLHIV following-up with complication to death were collected from the numbers of HIV/AIDS-illness-related deaths in 2012 only; this number was divided by 12 to give the number of events per month.

Three events were collected: A) an event of a PLHIV following-up without complication changing to following-up with complication (no-comp to comp), B) an event of a PLHIV following-up with complication changing to following-up without complication (comp to no-comp), and C) an event of a PLHIV following-up with complication to death. There is no event of a PLHIV following-up without complications changing to death from HIV/AIDS related disease.

Total numbers of PLHIV, new case and PLHIV following up with or without complication of each model are presented in Table 5.7. These data were collected during the time for a month of fieldwork study as in Chapter 4; however, they are used in the Table 5.10 for being parts of the calculations in the parameters and represented as a month as follow;

1. The community-based model (Model 1) had a total 307 PLHIV, of whom 3 were new cases, 271 were PLHIV following up without complication, and 33 were PLHIV following up with complication.

2. The doctor-led model (Model 2) had 984 PLHIV, of whom 14 were new cases, 898 were PLHIV following up without complication, and 72 were PLHIV following up with complications.

3. The mixed-comprehensive model (Model 3) had 235, of whom 13 were new cases, 204 were PLHIV following up without complication, and 18 were PLHIV following up with complication.

The percentage of events comprising PLHIV whose health status was changing from following up without complication to following up with complication were calculated from the three models of ART service and were used in the calculation of the comparison of the three models, presented as follows:

The total number of events of PLHIV from all models in the transition status of changing from following-up without complication to following-up with complication (no-comp to comp) was 123 (Table 5.10). Dividing this by the total number of PLHIV (not including new cases), 1,496, gives 0.082, so the figure which will be applied for the events of these PLHIV is 1: 0.082.

The proportion of events of PLHIV whose health status changed from following-up with complications to following-up without complications (comp to no-comp) were calculated from the three models of ART service and were used in the calculation of the comparison of the three models, as follows:

The total of events of these PLHIV was 113. This number is from the summation of events of PLHIV following up with complication from all models (no-comp to comp);

(123) minus the number of PLHIV who had opportunity to be PLHIV following up with complications for the next cycle of following-up (123 x 0.082 = 10.086).

Table 5.7 Events of change in health status of PLHIV from following-up without complications to following-up with complications, and following up with complications to death.

A. Events of PLHIV whose health status has changed from following up without complications to following up with complications (no-comp to comp)				
Model of ART service	Events of PLHIV whose status has changed from no-comp to comp per month in 2012	Parameter distribution	Total (minus new cases and event of status change from no- comp to comp)	Parameter distribution
Community-based model	**33**	Alpha	**271** (307-(3)-33)	Beta
Doctor-led	**72**	Alpha	**898** (984-(14)-72)	Beta
Mixed-comprehensive	**18**	Alpha	**204** (235-(13)-18)	Beta
Total *	**123**	**Alpha**	**1,373 (1,526-(30)-123)**	**Beta**
B. Events of PLHIV whose health status has changed from comp to no-comp				
Model of ART service	Events of PLHIV changed their states from comp to no – comp per month in 2012	Parameter distribution	Total (minus new cases and event of status change from comp to no comp)	Parameter distribution
Community-based	**29** (=33-(33x0.082))	Alpha	**4** (33-29)	Beta
Doctor-led	**67** (= 72-72x0.082))	Alpha	**5** (72-67)	Beta

Mixed-comprehensive	**17** (=18-(18x0.082))	Alpha	**1** (18-17)	Beta
Total *	**113 123-(123 x0.082)**	**Alpha**	**10 (123-113)**	**Beta**
C. Events of PLHIV changed their status from comp to death				
Model of ART service	Events of PLHIV from comp to death in 2012	Parameter distribution	Total (minus new cases and event of PLHIV dying of HIV/AIDS related illness)	Parameter distribution
Community-based	**14**	Alpha	**302.83** (307-(3)-(14/12))	Beta
Doctor-led	**16**	Alpha	**968.67** (984-(14)-(16/12))	Beta
Mixed-comprehensive	**9**	Alpha	**221.25** (235-(13)-(9/12))	Beta
Total *	**39**	**Alpha**	**1,492.75 (1,526-(30)-(39/12))**	**Beta**

Note: *Parameters of the total were applied in Markov analysis and Monte Carlo simulation for comparison of the calculated FTE among all three models

The key observation of this section was the parameter's distribution. Gamma, Alpha and Beta were specified from the data collected from the field work study as presented in this section; mean of time required to provide ART service of each type of healthcare provider, event of PLHIV following up with and without complication and new cases of ART services. Since the parameter distributions were indicated then the next section would be introduced the parameter to be applied in the formulae for Markov analysis.

5.3.2 Formulae of the calculation of probabilities in the Markov analysis for each length of cycle

The probabilities of transitional state, with complication, no complication and death are derived from the events of PLHIV in that particular health status, as the value of the Alpha, Beta and Gamma parameters which were applied in the calculation, and presented in Tables 5.9 and 5.10. The Markov analysis was carried out in Microsoft Excel 2010 (Microsoft Corp., Redmond, WA; Briggs et al. 2011). The parameters were allotted probability distribution to indicate the feasible range of value that each input parameter could reach (Tables 5.9 and 5.10).

1. First cycle: first following up visit

Formula:

Probability of complication state at cycle 1 (year 0)

= Probability of complication of previous cycle +

probability of complication state of current cycle

= (Probability of no complication of previous cycle x probability of transitional state from No complication state to complication state) +

(Probability of complication state of previous cycle x (1 - probability of transitional state from Complication to no complication - transitional state from complication to death related to HIV/AIDS)

Second cycle and further

1) Second cycle (1/12 = 0.083)

1. Status: no complication =

Probability of no complication state at cycle of second year

= Probability of no complication state remains as no complication +

Probability of transitional state from complication to no complication of previous cycle

= Probability of no complication of previous cycle x (1- probability of transitional status from no complication to complication – probability of transitional status from complication to death related to HIV/AIDS) + (probability of transitional status from complication to no complication of previous cycle probability of transitional status from complication to no complication of the current cycle)

2. Status: complication =

Probability of no complication of previous cycle x probability of transitional status from no complication to complication + (probability of complication of previous cycle x (1-probability of transitional status from complication to no complication – probability of transition status of complication to death related to HIV/AIDS))

2) Further cycle applies the same formula as presented in the second cycle

5.3.3 Uncertainty Analysis

Monte Carlo simulation was used to model the time required to provide ART services over a 99-year period, to cover the whole cohort of PLHIV expected to survive. The Monte Carlo analysis could ensure the results that were ramdom sampling by repeating random sampling to obtain numerical results**.** Monte Carlo methods are mainly used in three distinct problem classes draws from a probability distribution as this study was conducted.This probabilistic sensitivity analysis was carried out in Microsoft excel 2010 (Microsoft Corp., Redmond, WA; Briggs et al. 2011). I applied all input parameters to the sensitivity analysis. The parameters were allotted probability distribution to indicate the feasible range of value that each input parameter could reach. Alpha-, Beta- and Gamma-distribution were applied in order to ensure the calculated results of the Markov analysis were adequately randomised (Tables 5.9 and 5.10). Then Monte Carlo analysis repeated the process of the simulation, drawing one value from each distribution and giving the time required to provide ART services. These analyses were conducted to run the range of possible values according to the specified probability distribution. The results presented average values from probabilistic sensitivity analysis.

5.3.4 Result of Markov analysis and uncertainty analysis

The time required by each model of care to provide ART services is simulated by Markov analysis with the application of total events presented in Table 5.7. Table 5.8 shows a sample of the pattern of the formula for the probabilistic calculations of Markov analysis, leading to results and examples of input parameters. Similarly, this pattern of the formula for the probabilistic calculations of the Markov analysis was applied for Models 2 and 3.

Table 5.8 Pattern for the probabilistic calculations of Markov analysis leading to example of results and input parameters of Model 1

Cumulative proportion of year per monthly cycle	Age of PLHIV (year)	Probability of No-complication	Probability of Complication	Probability of Death from HIV/AIDS	Accumulate death	Total Probability	Time required per month to provide ART servicesto 1 PLHIV (minutes)		
							No-comp	Comp	Total
0.00	**15**	1.0000	0.0000	0.0000	0.0000	**1.0000**	**8***	**0***	**8***
0.08	15.083	0.9163	0.0822	0.0015	0.0015	1.0000	8	0	8
0.17	15.167	0.9151	0.0818	0.0017	0.0031	1.0000	8	0	8
0.25	**15.25**	0.9135	0.0817	0.0017	0.0048	**1.0000**	**8***	**1***	**9***
0.33	15.333	0.9120	0.0815	0.0017	0.0065	1.0000	8	1	8
0.42	15.417	0.9105	0.0814	0.0016	0.0081	1.0000	8	1	8
0.50	**15.5**	0.9090	0.0813	0.0016	0.0097	**1.0000**	**8***	**1***	**9***
0.58	15.583	0.9075	0.0811	0.0016	0.0114	1.0000	8	1	8
0.67	15.667	0.9060	0.0810	0.0016	0.0130	1.0000	8	1	8
0.75	**15.75**	0.9045	0.0809	0.0016	0.0147	**1.0000**	**8***	**1***	**9***
0.83	15.833	0.9030	0.0807	0.0016	0.0163	1.0000	8	1	8
0.92	15.917	0.9015	0.0806	0.0016	0.0179	1.0000	8	1	8
1.00	**16**	0.9000	0.0805	0.0016	0.0196	**1.0000**	**7***	**1***	**8***
1.08	16.083	0.8985	0.0803	0.0016	0.0212	1.0000	7	1	8
1.17	16.167	0.8970	0.0802	0.0016	0.0228	1.0000	7	1	8
1.25	**16.25**	0.8955	0.0801	0.0016	0.0244	**1.0000**	**7***	**1***	**8***
1.33	16.333	0.8940	0.0799	0.0016	0.0261	1.0000	7	1	8
1.42	16.417	0.8925	0.0798	0.0016	0.0277	1.0000	7	1	8
1.50	**16.5**	0.8910	0.0797	0.0016	0.0293	**1.0000**	**7***	**1***	**8***
1.58	16.583	0.8896	0.0795	0.0016	0.0309	1.0000	7	1	8
1.67	16.667	0.8881	0.0794	0.0016	0.0325	1.0000	7	1	8
1.75	**16.75**	0.8866	0.0793	0.0016	0.0341	**1.0000**	**7***	**1***	**8***
1.83	16.833	0.8851	0.0791	0.0016	0.0357	1.0000	7	1	8
1.92	16.917	0.8837	0.0790	0.0016	0.0373	1.0000	7	1	8
2.00	**17**	0.8822	0.0789	0.0016	0.0389	**1.0000**	**7***	**1***	**8***
…	…	…	…	…	…	…	…	…	…
65.25	**80.25**	**0.000**	**0.0000**	**0.0000**	**1.0000**	**1.0000**	**0**	**0**	**0***
Total time required to provide ART service for life year of one PLHIV (minutes)							**731***	**80***	**811***

Note: *Times to provide ART services were only recorded at one quarterly follow-up visit.

The result of the time (in minutes) required to provide ART services from the Markov analysis were further calculated to find the full-time equivalence (FTE) of providers. The FTE is calculated based on data of the available time of healthcare providers was estimated from observation of hours worked (7 per day) during the fieldwork study, for 220 days per year, 5 days a week, and 45 days off in a year based on data from Jirawattanapisalstudy (2009), as presented in Chapter 4. The results in Table 5.9 show that the doctor-led model (Model 2) required the least FTE, the mixed-comprehensive model (Model 3) required thenext lowest FTE, and the community based model (Model 1), the highest FTE.

Table 5.9 Time required to provide ART services by category of provider

Model	Time required to provide ART services (minutes per PLHIV life time)						
	All providers	Doctor	Nurse	Pharma cist	Pharmacy technician	Non-healthcare provider	Designated pharmacist
Model 1 Community-based							
Minutes per PLHIV	811	46	338	177	73	177	0
Hours per PLHIV	13.50	0.7652	5.6260	2.9407	1.2178	2.9407	0
Staff days required (assuming 7 hours per day)	1.9307	0.1093	0.8037	0.4201	0.1740	0.4201	0
FTE: Staff years required (assuming 220 days per year)	**0.0088**	**0.0005**	**0.0037**	**0.0019**	**0.0008**	**0.0019**	**0.000**
Model 2 Doctor-led							
Minutes per PLHIV	623	265	0	128	128	102	0
Hours per PLHIV	10.39	4.4120	0	2.1403	2.1410	1.6918	0
Staff days required (7 hours per day)	1.48	0.6303	0	0.3058	0.3058	0.2417	0
FTE: Staff years required (220 days peryear)	**0.0067**	**0.0028**	**0.000**	**0.0014**	**0.0014**	**0.0011**	**0.000**
Model 3 Mixed-comprehensive							
Minutes per PLHIV	636	71	0	105	105	97	258
Hours per PLHIV	10.59	1.1780	0	1.7482	1. 7515	1.6100	4.2978
Staff days required (7 hours per day)	1.51	0.1683	0	0.2497	0.2506	0.2300	0.6140
FTE: Staff year required (220 days per year)	**0.0068**	**0.0008**	**0.000**	**0.0011**	**0.0011**	**0.0010**	**0.0028**

To make the analysis a complete estimation of the time required to provide ART services to PLHIV, the time required for the one-time-only new cases should be added into the estimation. Table 5.10 presents the results of the time required in each model to provide ART services to new cases. The mixed-comprehensive model (Model 3) required the most, the doctor-led model (Model 2) the next highest, and the community-based model (Model1) the least. Of all cadres, doctors required the most time to deliver services to new cases.

Table 5.10 Time required to provide ART services to **new cases** by groups of providers in each model of care

Models	Time required to provide ART services (minutes per **new case** of PLHIV receiving ARV drugs)						
	All providers	Doctor	Nurse	Phar-macist	Pharmacy technician	Non health-care provider	Designa ted-phar-macist
Community-based (Model 1)	9.78	6.00	0	1.24	0.53	2.00	0
Doctor-led (Model 2)	11.15	5.79	0	2.15	2.15	1.07	0
Mixed-comprehen-sive (Model 3)	13.35	10.15	0	1.06	1.06	1.08	0

The FTE is calculated based on two sets of data: the time required to provide ART services, and the available time of healthcare providers per week and per year. I then applied the Markov model analysis to estimate the time required in each model of care to provide ART services to new casesusing a similar rationale to that applied for the time required for following-up PLHIV. Table 5.11 presents the FTE required in each model for new cases. The mixed-comprehensive model (Model 3) required the highest FTE, followed by the doctor-led (Model 2), and the community-based model (Model 1).

Table 5.11 The FTE providers for ART service for **new cases of ART**

Time required	FTE for new case of ART		
	Model 1 Community-based	Model 2 Doctor-led	Model 3 Mixed-comprehensive
Per new PLHIV receiving ARV in 2012 (minutes)	9.78	11.15	13.35
Per new PLHIV receiving ARV in 2012 (hours)	0.1630	0.1858	0.2225
Staff days required (assume 7 hours per day)	0.0232	0.0265	0.0318
Staff years required (FTE) over the lifetime of a new case (assuming 220 days per year)	0.00011	0.00012	0.00014

The FTE required to provide ART service to new cases was added to the FTE required to provide services to PLHIV following-up with and without complications. Table 5.12 presents the calculation of FTE of all providers required to provide ART services to new cases the three models of care. The community-based model (Model 1), required the highest FTE, the mixed-comprehensive model (Model 3) the next highest, and the doctor-led (Model 2) the least. The significant differences underpinning the similarity of FTE in Models 2 and 3 are descriptively analysed in Chapter 4.

Table 5.12 The FTE of all providers in the three models of care for the whole life of one PLHIV

Time required to provide ART service	FTE		
	Model 1 Community-based	**Model 2 Doctor-led**	**Model 3 Mixed-comprehensive**
FTE of PLHIV following up with and without complications	0.0088	0.0067	0.0068
FTE of new cases	0.00011	0.00012	0.00014
Total FTE providers	**0.0089**	**0.0068**	**0.0070**

The FTE of each type of provider were calculated and presented in Table 5.13. Doctors required the highest FTE followed by the ARV drugs delivering-activity and then non-healthcare providers delivering registration and diagnosis for following-up PLHIV without complications, task-shifted from doctors to nurses (Model 1) or pharmacists (Model 3), respectively.

Table 5.13 The FTE of ART services presented by each main type of healthcare provider delivering ART services

Models	**FTE for the lifetime of one PLHIV**						
	All providers	Doctor	Nurse	Phar-macist	Pharmacy technician	Non health-care provider	Designated pharma-cist
Community-based (Model 1)	**0.0089**	**0.0006**	**0.0037**	**0.0019**	**0.0008**	**0.0019**	**0**
Doctor-led (Model 2)	**0.0068**	**0.0030**	**0**	**0.0014**	**0.0014**	**0.0011**	**0**
Mixed-comprehen-sive (Model 3)	**0.0070**	**0.0009**	**0**	**0.0011**	**0.0011**	**0.0010**	**0.0029**

Considering the FTE of all providers to deliver ART services to one PLHIV per visit (every three months) for their lifetime, Table 5.13 presents the FTE for 1 PLHIV in a year. They visit hospital every three months, so the FTE fora year is the cumulative FTE of those 4 visits. Table 5.14 presents the FTE for 1,000 PLHIV in a year.

The table shows that the highest FTE of all healthcare providers was required by the community-based model (Model 1), followed by the doctor-led model (Model 2) and the mixed-comprehensive model (Model 3).

Table 5.14 The FTE required of ART services for one PLHIV in a year by each main type of healthcare provider delivering ART services

Models	FTE for one PLHIV per year						
	All providers	Doctor	Nurse	Pharmacist	Pharmacy technician	Non healthcare provider	Dedicated pharmacist
Community-based (Model 1)	**0.000362**	**0.000016**	**0.00016**	**0.000079**	**0.000033**	**0.000079**	**0**
Doctor-led (Model 2)	**0.000275**	**0.000115**	**0**	**0.000057**	**0.000057**	**0.000046**	**0**
Mixed-comprehensive (Model 3)	**0.000279**	**0.000024**	**0**	**0.000047**	**0.000047**	**0.000043**	**0.00012**
Models	**FTE for 1,000 PLHIV per year**						
	All providers	Doctor	Nurse	Pharmacist	Pharmacy technician	Non-healthcare provider	Dedicatedpharmacist
Community-based (Model 1)	**0. 362**	**0.016**	**0. 160**	**0.079**	**0.033**	**0.079**	**0**
Doctor-led (Model 2)	**0. 275**	**0. 115**	**0**	**0.057**	**0.057**	**0.046**	**0**
Mixed-comprehensive (Model 3)	**0. 279**	**0.024**	**0**	**0.047**	**0.047**	**0.043**	**0.120**

This section presented quantitative results calculated by Markov and Monte Carlo analyses, which answered the research questions of the estimated requirement of time to provide ART service, by provider, per year and lifetime of 1 PLHIV; FTE of each model of care. The findings showed that the doctor-led model required the lowest FTE, the mixed–comprehensive the next lowest, and the community based model the highest. All three models of care required about 0.28 to 0.36 FTE of all types of providers. The next section will show the estimation of the availability of healthcare providers, and any gaps there would be.

5.4 PROJECTION OF FTE OF HEALTHCARE PROVIDERS FOR PLHIV ACROSS THE COUNTRY

5.4.1 Applications of FTE for numbers of PLHIV from the report of the national database

As the data presented in the earlier section of this chapter (Section 5.2) shows, in 2012, the National AIDS programme (National Health Security Office 2012b) reported that 161,917 PLHIV were receiving ART services. The results of the FTE calculation from Table 5.14 (different models and types of providers) was applied for 161,917 PLHIV followed-up per year (Table 5.15).

Table 5.15 The FTE required for ART services for 161,917 PLHIV in a year by each main type of healthcare provider delivering ART services

Models	FTE for 161,917 PLHIV per year						
	All providers	Doctor	Nurse	Pharmacist	Pharmacy technician	Non health-care provider	Dedicated pharmacist
Community-based (Model 1)	58.61	2.59	25.91	12.79	5.34	12.79	0
Doctor-led (Model 2)	44.53	18.62	0	9.23	9.23	7.45	0
Mixed-comprehensive (Model 3)	45.17	3.89	0	7.61	7.61	6.96	19.43

The calculation can be multiplied by the estimated number of PLHIV in any year to give the FTE for that year; for instance, the estimated number of PLHIV wishing to access ART services in the future as 285,000 PLHIV in 2015 (Van Damme et al, 2008) as presented in Table 5.16.

Table 5.16 shows the FTE requirement of all healthcare providers for 161,917 PLHIV for the first year of treatment: 58 for the community-based model (Model 1) and 45 for both the doctor-led (Model 2) and mixed-comprehensive models (Model 3). As the projected number of PLHIV for 2015 is 285,000, the FTE will be almost double.

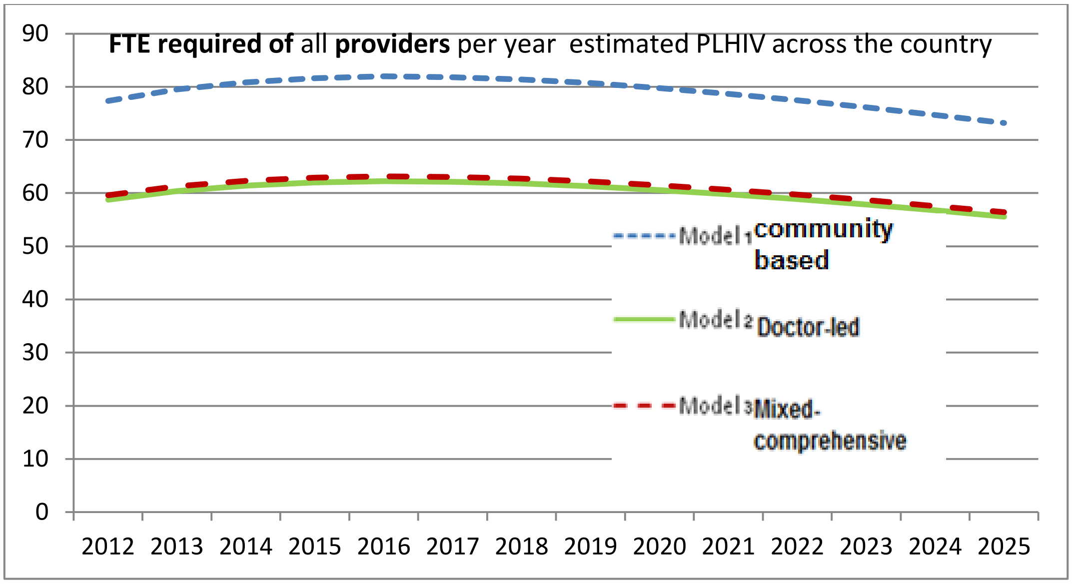
Table 5.16 The FTE required of ART services for 285,000 PLHIV in a year by each main type of healthcare provider delivering ART services

Models	FTE for 285,000 PLHIV per year						
	All providers	Doctor	Nurse	Phar-macist	Pharmacy technician	Non health-care provider	Dedicated pharma-cist
Community-based (Model 1)	103.17	4.56	45.60	22.52	9.41	22.52	0
Doctor-led (Model 2)	78.38	32.78	0	16.25	16.25	13.11	0
Mixed comprehend-sive (Model 3)	79.52	6.84	0	13.40	13.40	12.26	34.20

5.4.2 Applications of FTE for numbers of PLHIV from the data of the Asian Epidemic Model

The FTE of each cadre of healthcare provider, in each of the three models of care, was then applied to the numbers of PLHIV projected for the period between 2012 and 2025 by the Working Group on HIV/AIDS Projection 2008, presented in Figure 5.7 (Working Group on HIV/AIDS Projection 2008). This calculation shows that the highest FTE would be required by the community-based model (Model 1), the next highest by the doctor-led model (Model 2), very closely followed, however, by the mixed-comprehensive model (Model 3), (Figure 5.12).

Figure 5.12 The FTE required of all providers to provide three main activities of ART services in the three models of care



5.4.3 Calculation of availabilities and gaps in the health workforce

A. The demands and needs for the health workforce, by cadre, in each model of ART services

Numbers of PLHIV were used as input parameters to estimate the demand for services. The FTE of the health workforce required in each model of care to provide ART to PLHIV across the country was simulated, and Markov analysis was applied to the results (Figures 5.13 to 5.19inclusive).

Figure 5.13 shows that the doctor-led model (Model 2) required *six times* that required by the community-based model (five times that of the mixed-comprehensive), the mixed-comprehensive model (Model 3) required about double that required by the community-based model (Model 1).

Figure 5.13 The FTE **doctors** for the estimated number of PLHIV across the country, comparing the three models

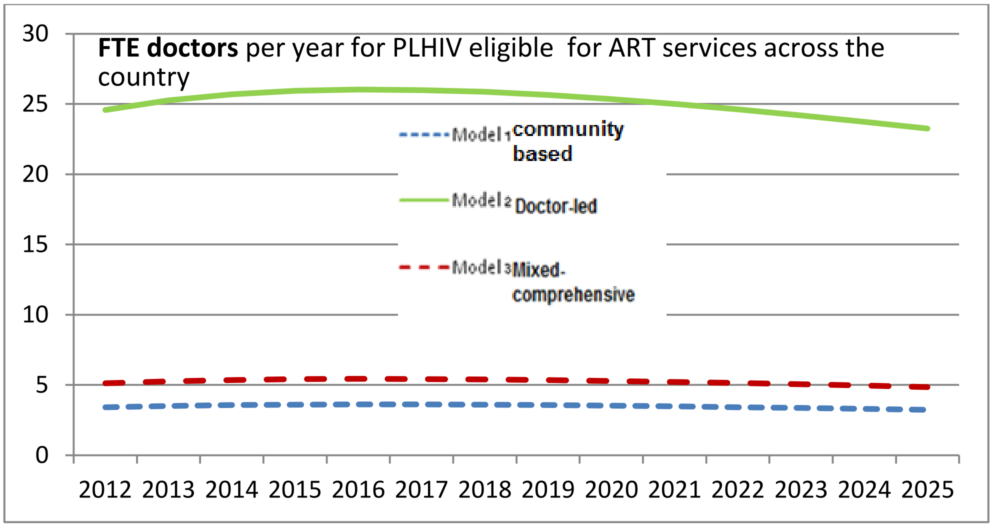
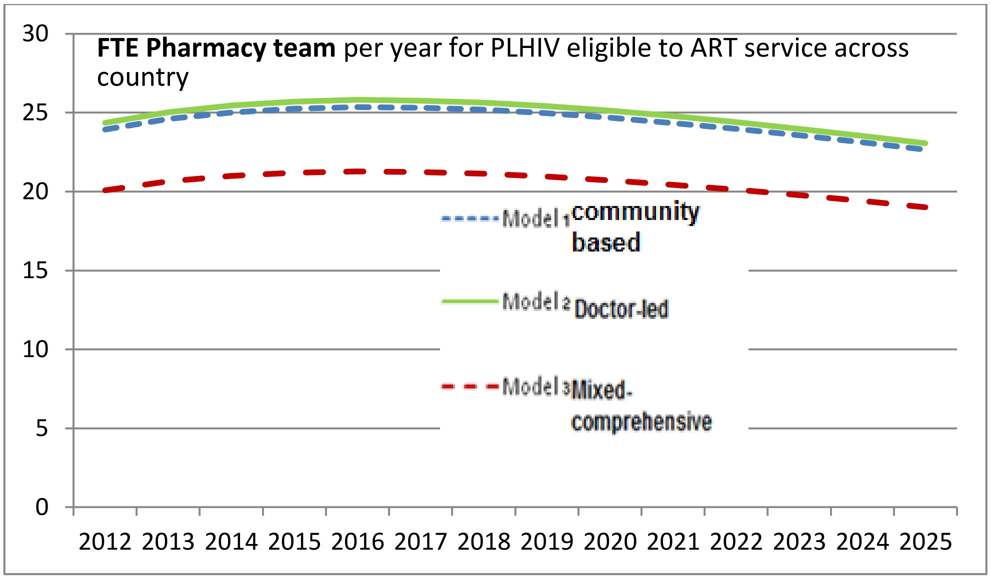


Figure 5.14 presents the FTE required from the pharmacy team which includes FTE required of pharmacists and pharmacy technicians. The doctor-led model (Model 2) required the most FTE pharmacy teamfollowed by the community-based model (Model 1), whereas the mixed-comprehensive model (Model 3) required the least.

Figure 5.14 The FTE **pharmacy team** for estimated PLHIV across the country, comparing the three models



With regard to the FTE of pharmacists, Figure 5.15 shows that the community-based model (model 1) has the highest FTE of pharmacists, followed by the doctor-led model (Model 2) and mixed-comprehensive model (Model3) who have very similar levels. Contrastingly, the FTE pharmacy technicians of the community-based model (Model 1) had the least, the doctor-led model the most, and the mixed-comprehensive was in the middle (Figure 5.16).

Figure 5.15 The FTE **pharmacists** for estimated PLHIV across the country comparing, the three models

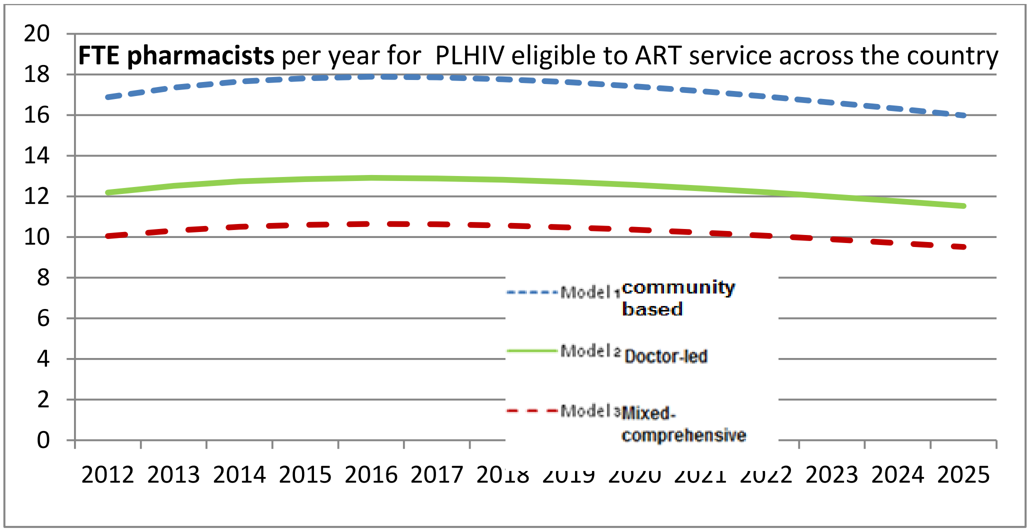


Figure 5.16 The FTE **pharmacy technicians** for estimated PLHIV across the country, comparing the three models

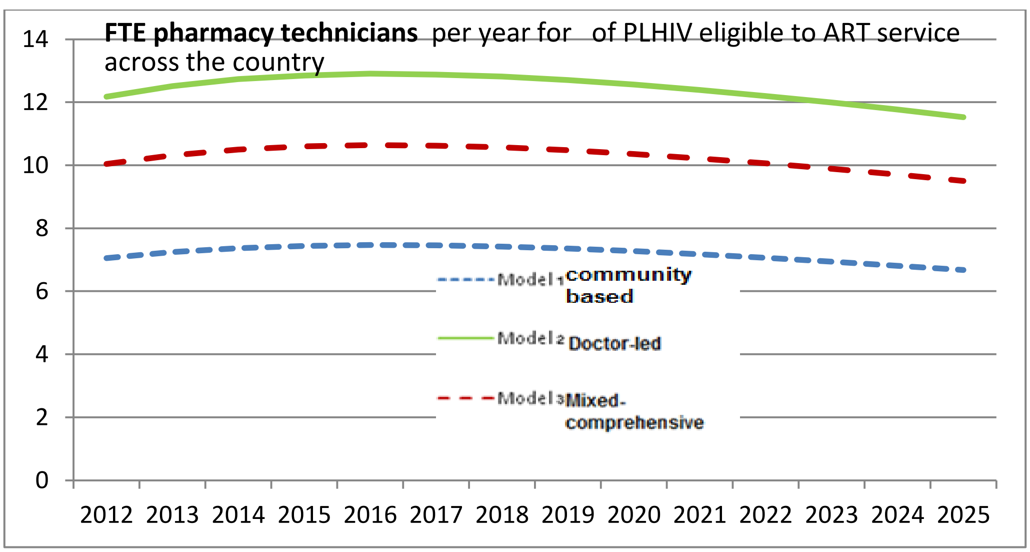


Figure 5.17 shows that the community-based model (Model 1) required the most FTE of non-healthcare providers, who were the volunteers assisting healthcare providers, followed by the doctor-led (Model 2) and mixed-comprehensive model (Model3) who had very similar levels.

Figure 5.17 The FTE of **non-healthcare providers** for the estimated numbers of PLHIV across the country, comparing the three models

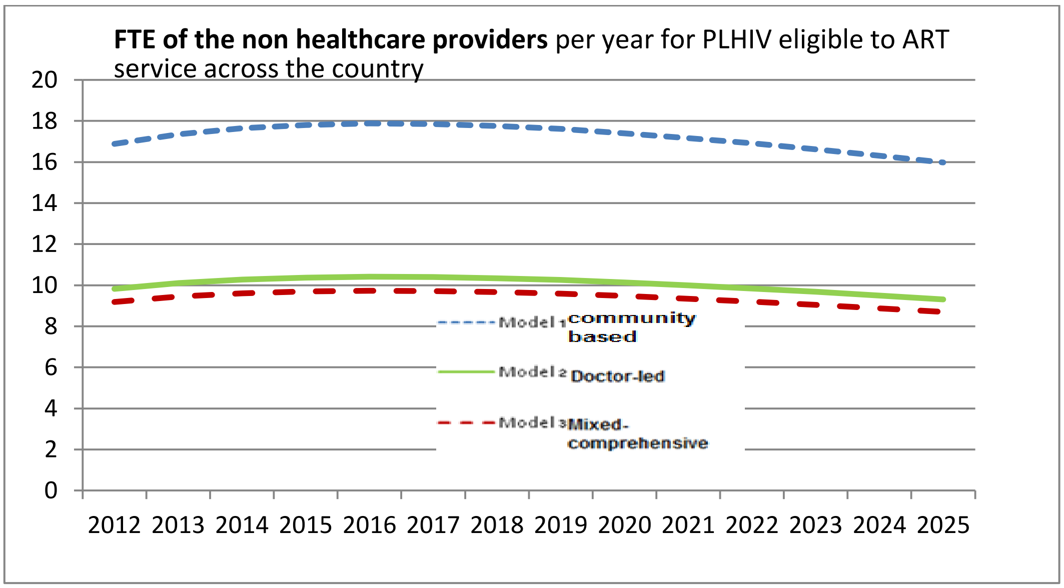
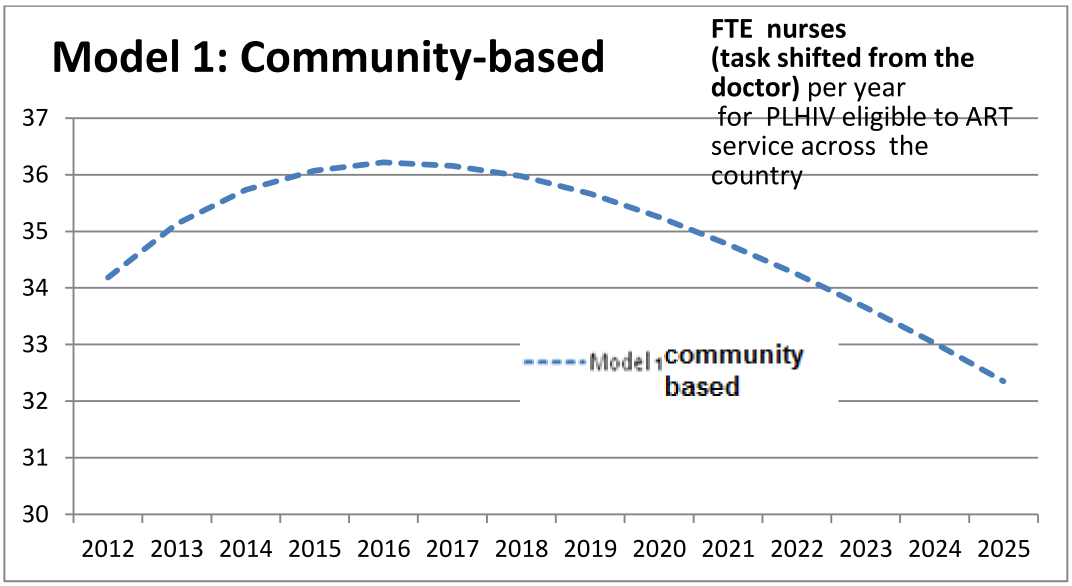


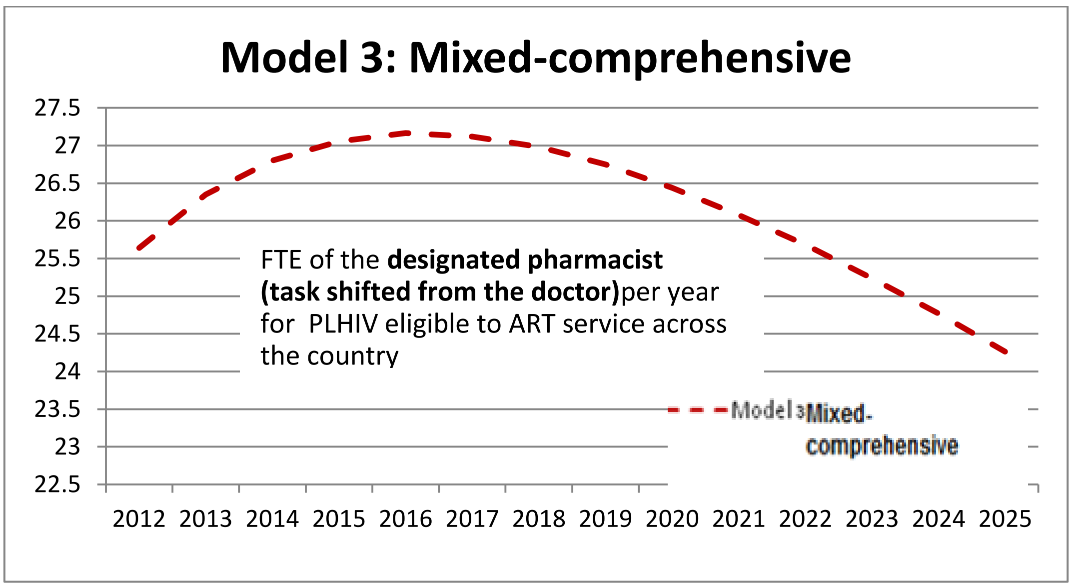
Figure 5.18 shows the FTE required for nurses providing ART service tasks shifted from the doctor (Model 2), in the community-based model of care (Model 1), projected for the period from 2012 to 2025. It is only in the community-based model that tasks usually carried out by doctors are shifted to nurses, but only in the case of PLHIV following-up without complications.

Figure 5.18 The FTE **nurses** for estimated PLHIV across the country comparing, the three models



In a similar way, it is only in the mixed-comprehensive model (Model 3) that ART tasks normally carried out by the doctor are shifted to the designated pharmacist, again, only in the case of PLHIV following up without complications. FTE for the designated pharmacist projected for the period 2012 to 2025 is presented in Figure 5.19.

Figure 5.19 The FTE **designated pharmacist** for estimated PLHIV over the country, comparing the three models

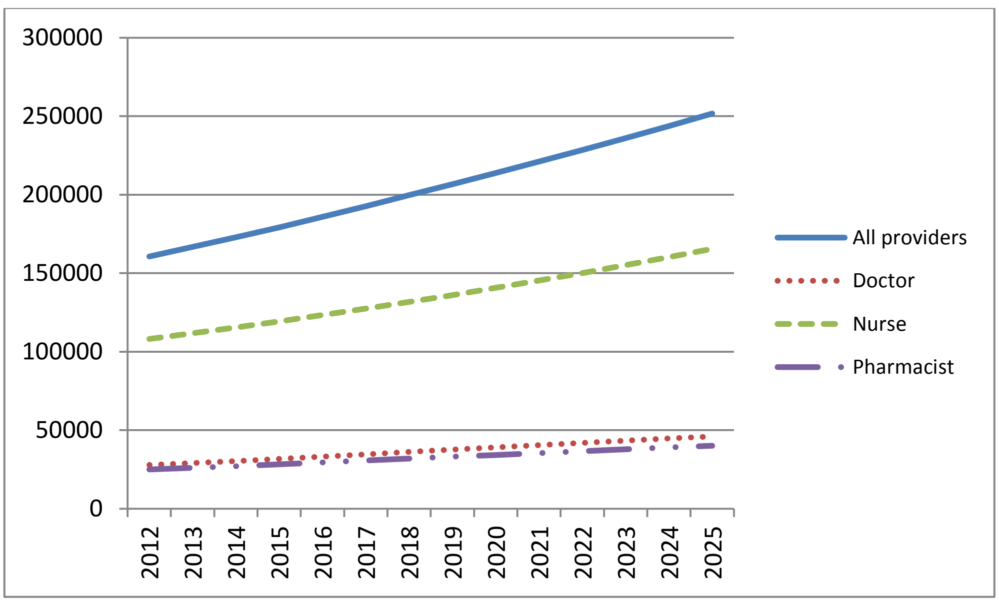


This section presented the quantitative results of the estimations of FTE required of healthcare providers for ART services. The finding showed differences of the requirement, which depends on the contexts of each models of care. The main points were that the doctor-led model required FTE doctor the most whereas the community based model and mixed-comprehensive model required FTE doctor lesser because these two models applied the task-shifting shifted tasks of ART service from doctors to nurses or designated pharmacist. The next section presented the projection and the estimation of availabilities of healthcare providers and the estimations of requirement and availability of healthcare providers.

A. Projection of availability of the health workforce

This study calculated and projected the availability following assumptions and data collected from the Thailand health profile and literature review, as presented in Section 5.2. Figure 5.20 presents graphs showing the availabilities of the main cadres of the health workforce as the supply side of provision of ART services. All main providers showed an increased trend of availability, doubled from 2012 to 2025. Nurses are projected to have the highest availability, tripled from the original numbers by 2025 when compared with other cadres: doctors and pharmacists show a smaller increasing trend.

Figure 5.20 Availabilities of main cadres of the health workforce



B. Percentage of the needs as FTE of main health workforce providing ART services

This study applied the projected numbers of the health workforce to the results of FTE simulation of the three models (Figures 5.21 to 5.27) to calculate the percentage of need as FTE, and the projected number of available health workforce personnel. Overall, the mixed-comprehensive model (Model 3) and the doctor-led model (Model 2) would have about 0.02-0.04% of the needs and availabilities in the period 2012 to 2025, whereas the community-based model, which had the highest percentage of needs and availabilities, would have 0.03-0.05%. However, all three models were estimated to show decreasing trends of the percentage of FTE because of the increasing trend of availabilities. This figure obviously represents a very small percentage of the Thai healthcare services when we consider the overall workload of the health workforce. It seems the Thai healthcare system will be able to deliver almost all the required ART services.

Figure 5.21 Percentage of the requirement of all providers and their availabilities, to provide ART service per year for all PLHIV across the country

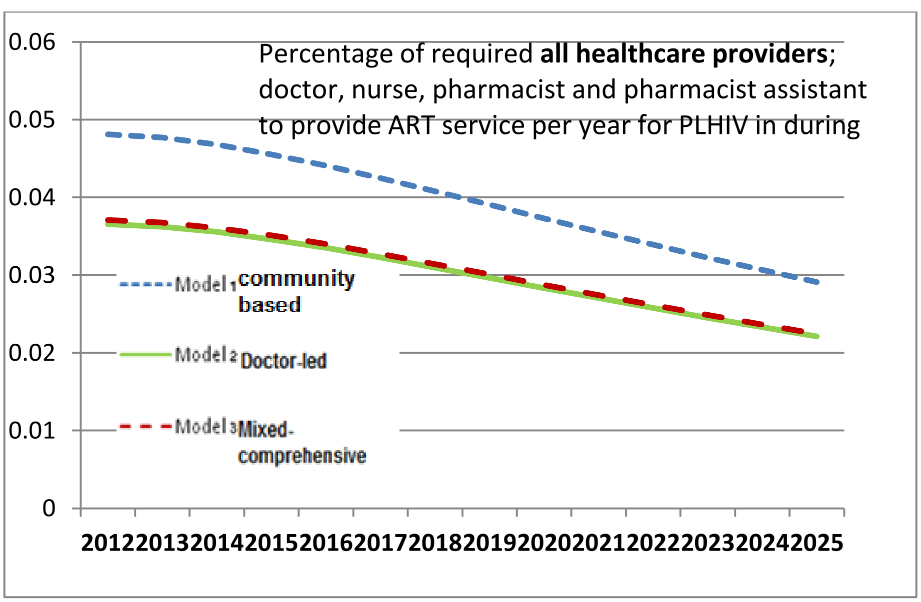
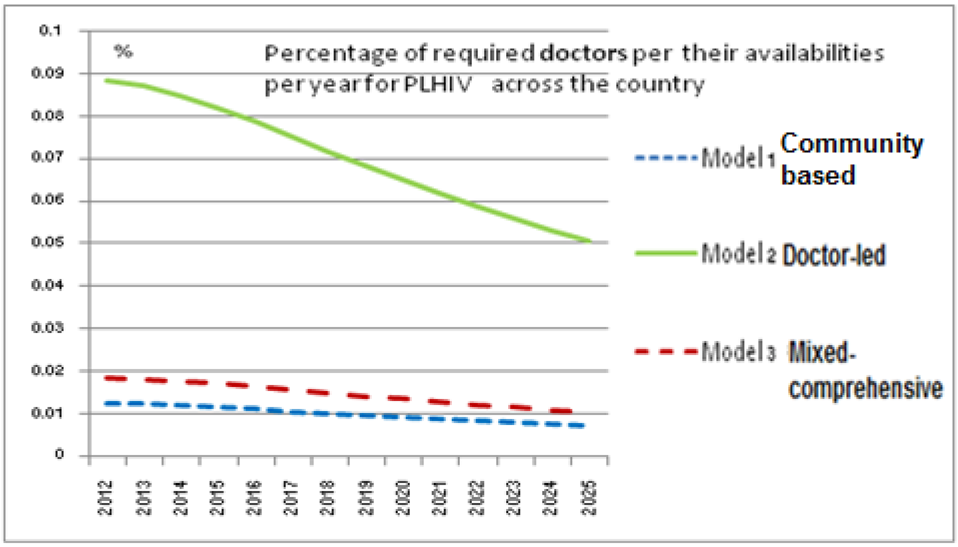


Figure 5.22 shows the percentage of the requirement of doctors in the doctor-led model, which has the highest percentage of the FTE of doctors and also of their availability: over four times as many as the other two models.

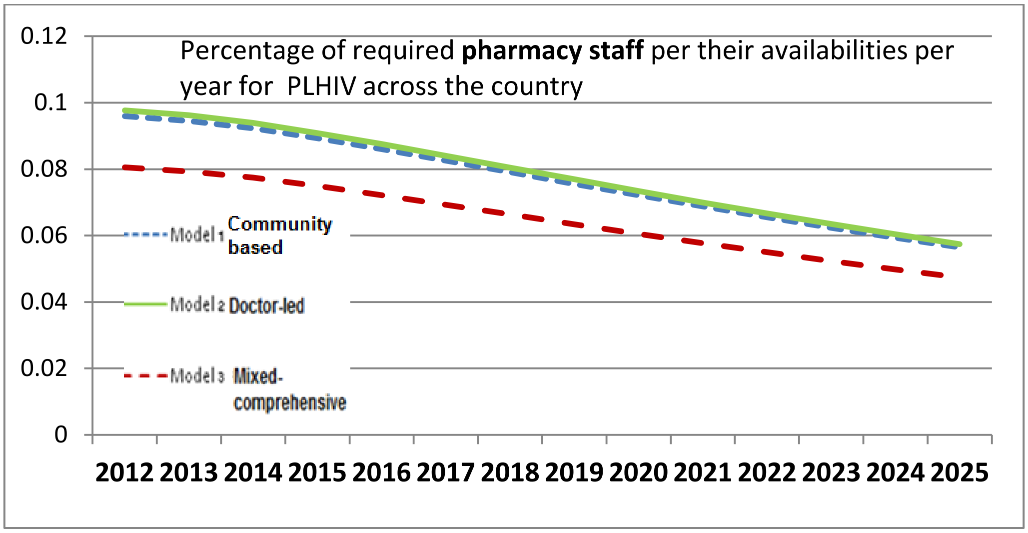
Figure 5.22 Percentageof the FTE requirement of doctors

and their availabilities for all PLHIV over the country



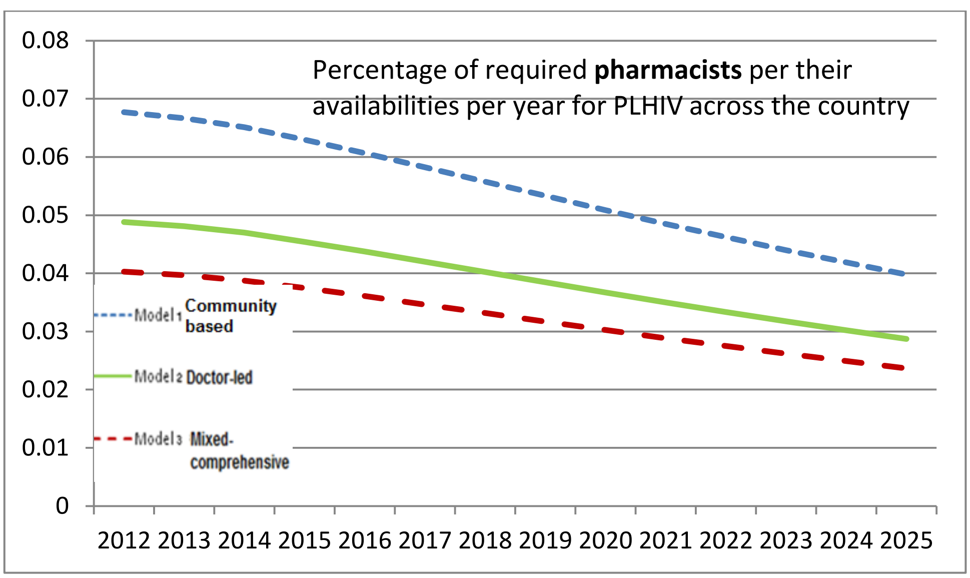
Similarly, there were similar trends of the proportion of required pharmacy staff (pharmacists and pharmacy technicians) among the three models. The doctor-led model has the highest percentage, followed by the mixed-comprehensive and the community based the least (Figure 5.23).

Figure 5.23 Percentage of the FTE requirement of pharmacy staff and their availabilities



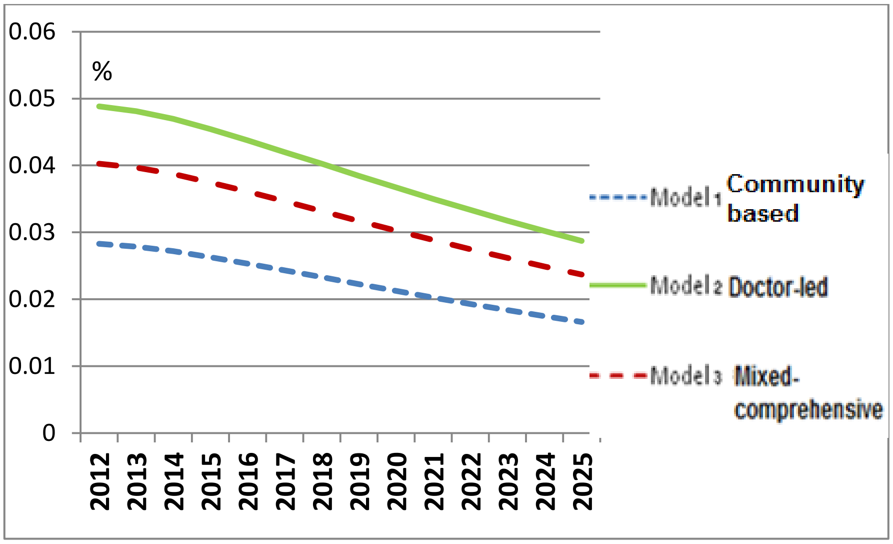
Considering only the percentage of the requirement of pharmacists, Figure 5.24 demonstrates that the community-based model has the highest proportion, followed by the doctor-led model, and the mixed-comprehensive model the least.

Figure 5.24 Percentage of the requirement as FTE pharmacists and their availabilities



The percentageof the requirement, and the availability of the pharmacy technician of the doctor-led model is highest followed by the mixed-comprehensive and community-based model, respectively (Figure 5.25).

Figure 5.25 Percentage of the FTE requirement of pharmacy technicians and their availabilities



For the percentage of the requirement and availability of nurses to whom the doctor shifted tasks in the community-based model of care: over 3 % in 2012 before decreasing slightly to less than 2% in 2025 (Figure 5.26).

Figure 5.26 Percentageof the requirement as FTE nurses and their availabilities, of the community-based model (Model 1)

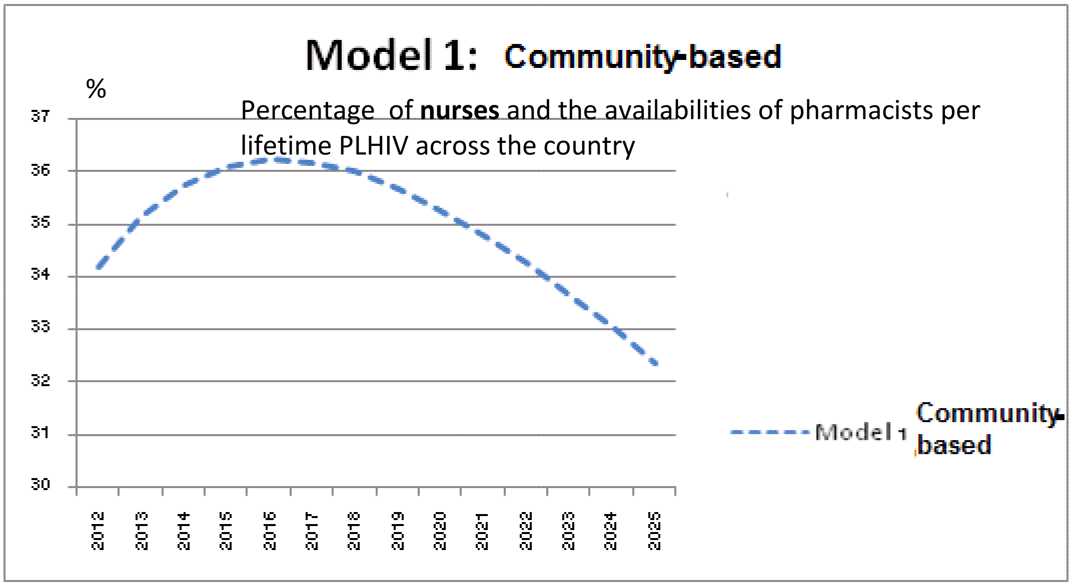
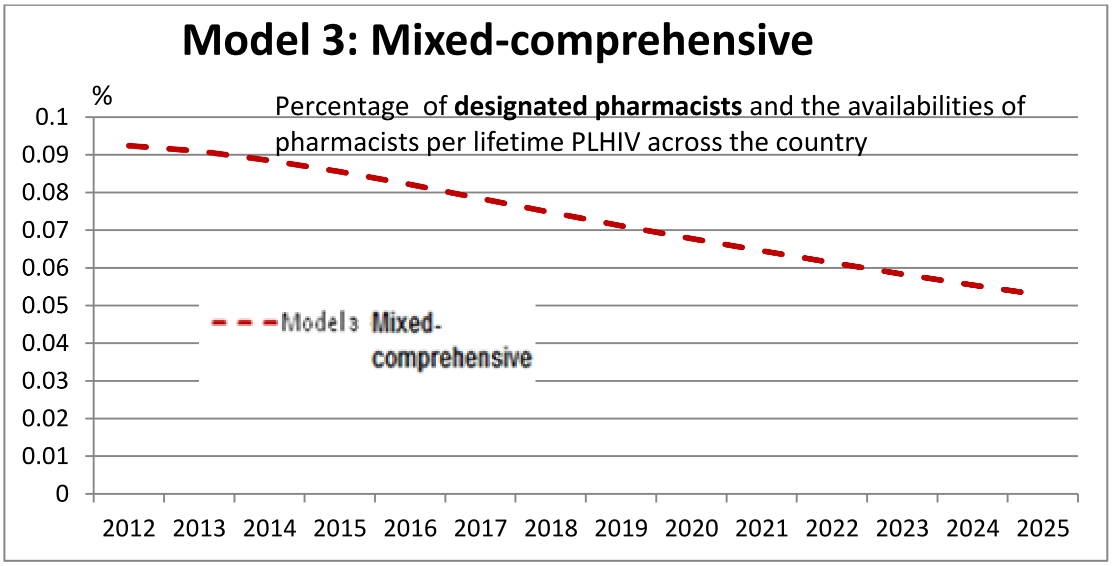


Figure 5.27 shows that only in the mixed-comprehensive model does the doctor allow the designated pharmacist to provide ART services; however, the FTE percentage shows a declining trend, and will be slightly over half its present level in 2025.

Figure 5.27 Percentage of the requirement as FTE of designated pharmacists and their availabilities, of the mixed-comprehensive model



5.5 SUMMARY OF MAIN FINDINGS

This chapter presents the results of the secondary data collection in terms of demand and supply of health workforce requirement and gaps for ART service. The FTE of all types of providers were projected from the data from Chapter 4; time required to provide the ART service of each type of provider for each activity of ART service. Some data from secondary data sources were applied as projected numbers of PLHIV, and healthcare providers were also input for Markov analysis, to projecte the FTE of providers for different estimated number of whole lives of PLHIV, by year, as the finding of this chapter.

From point-of-view of demand, the numbers of PLHIV who have received ARV drugs, and their projection for the period 2012 to 2025, decreased slightly from a peak of 285,000 to 250,000. From point-of-view of supply, the numbers of public sector healthcare providers representing the four main cadres delivering ART: doctors, nurses, pharmacists and pharmacy technicians. The numbers of physicians were estimated from the existing public sector pool for the period from 2012 to 2030, with estimating growth 88.86%. The supply of professional nurses was estimated as growing from 2012 to 2030, with estimating growth 79.49%. The supply of pharmacists and pharmacy technicians were estimated as growing from 2012 to 2030, with estimating growth 84.45%.

The next finding presented in this chapter is the workload, which refers to the time required to provide ART services. These times, in the three different models of care, were applied for Markov analysis. The results for three different groups of PLHIV, categorised by three different states of health and treatment: follow-up without complications, follow-up with complications, and new cases, are presented. The time required to provide ART services to new cases was significantly the highest: between 9-14 minutes for each new-case PLHIV for the one visit in which they fell into this category, higher than the 10-13 minutes required for one visit per PLHIV following-up with complications, and the 6-8 minutes required for PLHIV following-up without complications. The community-based model at Sanpatong District Hospital required the most time to deliver ART services, an average of 8.47 $\pm$ 3.08 minutes (mean $\pm$ SD); Chonburi Regional Hospital, employing the doctor-ledmodel, required the least, an average of 6.54 $\pm$ 2.58 minutes (mean $\pm$ SD); and Prachuap Khirikhan Provincial Hospital, employing the mixed-comprehensive model, required an average of 7.00 $\pm$ 3.39 minutes, the intermediate time.

The three models of ART services assigned task allocations differently to PLHIV following-up without complications. In Model 1 (community-based) and Model 3 (mixed-comprehensive), doctors delegated all diagnostic tasks to other professionals: nurses in Model 1, and a designated pharmacist in Model 3. In the doctor-led model, all diagnosis was carried out by the doctor. All models of care used non-healthcare workers to deliver registration services. The other main ART activity, drug delivery, was provided by the pharmacy team.

Markov analysis was applied for an estimation of the time required to provide ART services for the period 2012 to 2025. There were three possible states for PLHIV follow-up in each cycle: 1) follow-up without complications (no comp), 2) follow-up with complications (comp) and 3) AIDS related death (death). PLHIV were followed-up quarterly at the ART clinic. For their first visit and first cycle of treatment with ARV drugs, they were defined as new cases. After this visit, they became PLHIV who followed-up; it was assumed that they would follow-up without complications, with a transitional probability. These PLHIV followed-up for the second and subsequent cycles. PLHIV were assumed to pass through their transitional states as cycle-length per month, and the model for a life expectancy of 100 years: 99 cycles starting from 15 years old. Then the last age of following up would be 85 years.

The first parameter is the Gamma distribution: mean and standard errors, which can be any value from zero to infinity. The Gamma distribution of this study is the mean of time required to provide ART services in each model and each type of healthcare, by treatment status of PLHIV.

The other two parameter distributions are Alpha and Beta. In this study, the Alpha parameters represent three kinds of events: 1) PLHIV following-up without complications, but with the possibility of complications (no-comp to comp), 2) PLHIV following-up with complications, with the possibility of moving to the event of non-complication (comp to no-comp) and 3) the numbers of PLHIV following-up with complications leading to death (comp to death). The Beta parameter is the health status event of the total number of PLHIV regardless of the health status event represented by the Alpha parameter.

The events of PLHIV in any particular health status, as the value of the Alpha, Beta and Gamma parameters were calculated as the probabilities of transitional state, with complication, no complication and death. Markov analysis was carried out in Microsoft Excel 2010 (Microsoft Corp., Redmond, WA; Briggs et al. 2011). Monte Carlo simulation was used to model the time required to provide ART services over a 99-year period, to cover the whole cohort of PLHIV expected to survive. This probabilistic sensitivity analysis was carried out in Microsoft Excel 2010 (Microsoft Corp., Redmond, WA; Briggs et al. 2011).

The results of the Markov analysis were presented as the time requirement in minutes, and were further calculated to find the full-time equivalence (FTE). The FTE is calculated based on estimated data, from both observations during the fieldwork study and literature review, of hours worked (7 per day) for 220 days per year.

The results show that the the community-based model (Model 1) required the most FTE, the mixed-comprehensive model (Model 3) the next highest, andthe doctor-led model (Model 2) the least. Among allcadres, theART service required most doctor's time to deliver the services. The FTE for one PLHIV per year was a standard unit that could be applied to other groups of PLHIV. The estimation showed that the total number of PLHIV in 2012: 161,917, required 45 to 60 FTE of all providers (3-20 FTE of doctors, 25 FTE of nurses, 8-20 FTE of pharmacists and 6-10 of pharmacy technicians, and 7-13 FTE of non-healthcare providers). The requirement for the 285,000 PLHIV estimated for 2015 was double that required in 2012.

The FTE of each cadre of healthcare provider, in each of the three models of care, was then applied to the numbers of PLHIV projected for the period between 2012 and 2025 by the Working Group on HIV/AIDS Projection 2008. This calculation shows that the highest: 80 FTE of all providers, was required by the community-basedmodel (Model 1), the next highest, 60 FTE, by the doctor-led model (Model 2), very closely followed, however, by that of the mixed-comprehensive model (Model 3).

Considering the estimation by cadre of provider, the results show that the FTE of doctors required by the doctor-led model (Model 2) was five times the FTE required by the mixed-comprehensive model (Model 3), and *six* times the FTE required by the community-based model (Model 1). In the mixed-comprehensive model, ART tasks were shifted from doctors to designated pharmacists, whose FTE was 24-27, and in the community-based model (Model 1), tasks were shifted from doctors to nurses, whose FTE was 32-36. Then the FTE required of doctors in these two models were less. The community-based model, the FTE nurses was estimated as 32-36. Similarly, the mixed-comprehensive model, that ART tasks normally carried out by the doctor are shifted to the designated pharmacist which had 24-27 FTE pharmacists.

For drug dispensing, FTE is that of the pharmacy team, consisting of pharmacists and pharmacy technicians. At 25, the doctor-led model (Model 2) has the highest pharmacy team FTE, followed by the community-based model (Model 1) and the mixed-comprehensive model (Model 3), both having a pharmacy team FTE of 20.

Non-healthcare providers carried out ART service registration in all models of care. At 18, the community-basedmodel (Model 1) had the highest FTE of non-healthcare providers, followed by the doctor-led model (Model 2) and mixed-comprehensive model (Model 3), with very similar FTEs of 10 and 8, respectively.

This study applied the projected numbers of the health workforce to the results of FTE simulation of the three models, to calculate the proportions of need as FTE, and the projected numbers of available health workforce personnel. Overall, the mixed-comprehensive model (Model 3) and the doctor-led model (Model 2) would have about 0.02-0.04% of the FTE required and availabilities for the period 2012 to 2025, whereas the community-based model, which had the highest percentage of needs and availabilities, would have 0.03-0.05%. However, all three models were estimated to show decreasing trends of the proportion of FTE because of the increasing trend of availabilities. This figure obviously represents a very small percentage of Thai healthcare services when we consider the overall workload of the health workforce. It seems the Thai healthcare system will be able to deliver almost all the required ART services. However, this study aims to provide a tool for the estimation of the future health workforce for ART.

Considering the percentage of the requirements and availabilities of doctors, the doctor-led model showed the highest proportion of the FTE of doctors and also of their availability, which at 0.09% is over four times that of the other two models. This is an interesting point that we may consider as a gap.

For the proportions of requirements and availabilities of other cadres, there were similar trends in the percentage of required pharmacy staff (pharmacists and pharmacy technicians), among the three models. The doctor-led model had the highest proportion: 0.06 to 0.1%, followed by the mixed-comprehensive and community-basedmodel with 0.04 to 0.08%. These proportions may not reflect a gap in the healthcare system from the results of the estimation; however, there may be a gap in the health system from other factors not identified by this study that the calculation might not be able to reflect.

5.6 CONCLUSION

This chapter has shown the estimations of demand and supply of the health workforce required to deliver ART servicesand the estimation of time required, availability and gaps analysis of health workforce to deliver ART services as FTE. These data became the input parameters for the Quantitative analysis. The three types ofalternative ART models had minor differences in HR requirements. In general, the doctor-led model had the lowest FTE requirement, followed by the mixed-comprehensive, the community-based model having the highest. Markov analysis proved to be a tool developed for projecting FTE required to provide ART service and answered the research questions that there were no huge requirements or gaps of providers to deliver ART service between the case study of three models of care representing all four facility levels of healthcare service in Thailand.

The other main result is the percentage of need and availability of healthcare providers, which was approximately 0.04-0.05% of FTE required for all providers. In other words, ART provision requires a very low proportion of FTE time of the active workforce in any one year. However, significant variations in the requirements for each type of provider in each model of care mean that they need to be considered separately. The percentage of need and availability of healthcare providers does not accurately reflect the gaps in requirement. In actuality, the figure for the availability of healthcare providers does not take into account the many non-ART related activities they carry out. This was the best the tool developed in this study could achieve with the resources and data available. Future studies, building on this one and using the same tool, and data more specific to the availability of healthcare providers involved only in ART services, should be able to elicit a far more accurate analysis.

CHAPTER 6

DISCUSSION AND CONCLUSIONS

6.0 INTRODUCTION

In this chapter, the research findings are discussed in order to answer the research questions and link to the objectives of the study. Section 6.1 discusses the significance of the present deployment of staff in three models of care at four different levels of service.In Section 6.2 the conclusions answer the research questions: whether the existing models of ART service in the different levels of care increase access; how the selected hospitals have adapted the ART model to deliver ART services; what the projected requirements, capacities and potential gaps in human resources in ART delivery services are, at the four different levels of care, during the period from 2012 to 2025, will be; and finally, the generalisability of the adapted ART models.However, even though this study is able to answer the research questions; there were some limitations of the research methods, specific to the conditions of the study, as presented in Section 6.3.

The questions generated by these conclusions suggest possible areas for further research and recommendations, presented in Section 6.4. Section 6.5 summarises this research study.

Research objectives

1. To investigate and identify existing models of different ART delivery services from a case study of six hospitals at four different levels of care.

2. To suggest how selected hospitals can feasibly adapt their approaches to the delivery of ART services, in order to increase access and coverage, whilst maintaining and increasing accessibility and quality of care.

3. To develop and test a tool to estimate the requirements, capacities and gaps in human resources, in response to the demands of the policy of universal access to ART services, from 2012 to 2025, by modelling the implications for human resources; varying with an increase in the CD4 count enrolment level from 200 to 350 cell/mm^3, based on evidence from the case study hospitals.

4. To generate specific policy recommendations for adapting models of care; these recommendations to be generalisable nationwide.

Research questions

1. How do hospitals in Thailand, at all fourlevels of care, deliver ART services?

2. What adaptations to the models of ART service appear to be feasible, to increase access to, and coverage of, ART services, whilst maintaining and improving accessibility and quality of care?

3. Would a newly developed tool be able to be applied to estimate future requirements of the health workforce for ART service delivery?

4. What will be the requirements, capacities and gaps in human resources in the ART delivery service at the four different levels of care during the period from 2012 to 2025?

6.1 ART SERVICE DELIVERY

The achievement of these aims, in particular universal coverage of ART services by global communities, will have immediate and long-term consequences for human resources in the provision of healthcare services, since ART is recommended to extend life by reducing mortality and morbidity (Wolrd Health Organization 6a)

The achievement and maintenance of the universal coverage of healthcare services are tasks requiring the health sectors of each country to expand the capacity of their healthcare services, usually requiring an expansion of the health workforce (Dreesch et al. 2005; O'Brien-Pallas et al. 2001; Schofield 2012; Stephanie and McDonald 2012;).

Accordingly, in Thailand, the UC for ART services policy, and two other important factors: change of enrolment criteria for PLHIV who have a high CD4 level to access ART services; and the decentralisation policy transforming all health centres to sub-district hospitals, identified by this study; which confront the healthcare system, drovethis thesis, which explored HRH issues contingent on these changes to HIV/AIDS treatment in the healthcare system.

Firstly, the aim to increase access to, and coverage of, ART services, by implementing universal coverage of ART services across the country, necessitates a long term investment in ART services, to ensure quality and efficiency of treatment. Secondly, clinical developments in ART services and associated healthcare services, and an enlargement of the enrolment criteria, mean that the healthcare system has had to absorb the increasing needs of ART services. Lastly, a major change to the organisation of facilities, which saw community health centres across the country turned into sub-district hospitals, in order to provide healthcare services at the community level. The increases in the demands of ART service provide impact directly to the HRH requirement. The existing HRH in the healthcare system have to provide ART service without any accompanying increasein numbers.This has had a direct impact on health system infrastructure and management.

6.1.1 Characteristics of ART services in the three models of care

A. Quality of ART service

This study investigated the deployment patterns of ART delivery servicein all four facility levels of care. The outcome interms of quality of care measured by the increased of CD4 level. The finding from Chapter 4 show that all three models of care managed to maintain/increase quality of care, i.e. an increased CD4 level. Although most PLHIV in all three models had CD4 count in levels of about 200 cell/mm^3 before starting treatment, after receiving ART, they showed over double this starting level: on average 470 cell/mm^3 (Figure 4.3, 4.12 and 4.18). This indicates that all models of care providing ART services lead to an increase in CD4 levels as an outcome of treatment (there was no significant difference ($P< 0.05$) betweenthem), as reported in many study that ART prolong lives and reduce motality and mobidity of PLHIV with quality fo ART service (World health organization, 2006a). The quality of care presenting with the increased CD4 level, suggests that each model of care is equally effective. But quality of care as measure by loss to follow up is different which is very interesting as it was not expected at the start of this study. The result from this study is similar to the results from experiences of other countries, which providing with high quality of care in Rwanda, Mozambique, Malawi, Cameroon and South Africa, (Gimbel-Sherr et al. 2008; Wood et al. 2009), Zambia and Uganda (Bolton-Moore et al. 2007; Chang et al. 2009).

B. Efficiency of ART service

The increase in CD4 level after PLHIV receiving ART service and the low rate of loss to follow up of PLHIV could reflect the efficiency of the ART service. It is because it leads to a good clinical outcome of treatment: the ultimate goal of ART (Ministry of Public Health and World Bank 2004; Stover et al. 2008; Torpey et al. 2010; Wagner et al. 2007; World Health Organization 2006e). My study found two models of ART service; the mixed-comprehensive and the community-based models of care had very lowrates of loss to follow-up presenting high efficiency, the mixed-comprehensive model, the most, the community-based the middle and the doctor-led model, the least. The study gave the reasons that is because these models applied community-based approach and home-visit carried out by NGO volunteers in the mixed-comprehensive model, in the event of missed appointments, are an even more effective way of preventing loss to follow up. This reflects the efficiency of a more community-based approach which I did not expect to see it before I started this study.

The results from this study was found similarly to results from studies in other countries such as the study of in Lesotho and Rwanda (Cohen et al. 2009) and the home-based care study in South Africa, Uganda and Malawi (Jaffa et al.2004; Wedle et al. 2006) which found high quality outcome interm of motality and retention to the ART services which reflects directly to high efficiency of care.

The advantage of the efficiency of ART service presented with adaptations of ART delivery models of this study and the studies in other country. The experiences of implementing community-based approach were shown in most countries in sub-Saharan Africa, government have taken lead scaling up ART sevice along with the community-based approach (Arem et al. 2009; Wagner et al. 2007; Wolrd Health Organization 2004a; Chang et al. 2009).

C. Accessibility and coverage of ART services

This study shows that there was an increase in access to ART services of PLHIV in all three models of care. The community-based model providing ART service at the community level of care allowed PLHIV to access ART services near their homes so that they did not need to travel to receive ART. In the doctor-led and mixed-comprehensive models, PLHIV had to travel, often a considerable distance, to be followed up at the regional or provincial hospital. Any claims regarding improved access to ART must be treated with care, as this study did not specifically attempt to measure variations in access with any statistical tests. However, there is scope to explore this aspect of ART provision in Thailand.

The decentralised approach places ART delivery services in communities. On the other hand, without strengthened healthcare systems, some studies have shown that many developing countries are unlikely to achieve a high level of access to ART, bearing in mind the gaps in financing and the human resource crisis (Schneider and et al 2006).

The decentralised approach has been appliedto practice in other countries. Brazil, Argentina, Mexico, Ukraine, China, Lesotho, Mozambique, and Zambia took district-approaches to the delivery of ART services, by training nurses and community health workers to deliver them in community hospitals (Hanefeld and Masheke 2009; 2010; Kober and Van Damme 2006; Pan American Health Organization 2003; Steyn et al. 2009b; Van Damme and Kegels 2006; Van Rensburg et al. 2008; Wagner et al. 2007; World Health Organization 2004a). However, it has sometimes failed to increase the accessibilty of ART services in South Africa (Fairall 2011). This differs from the resultsof my study, where an increase of access to ART services was found in all models of care which silmilar to many studies in increasing access in healthcare, such as in Botswana, Zambia, and Sout Africa (Gioris et al. 2009).In comparison, there were more advantages to apply community-based approach in terms of access and coverage.

6.1.2 Good practices identified in ART service

A. Task-shifting in all three models of ART services

According to the World Health Organization, task shifting is the “process of delegation whereby tasks are moved, where appropriate, to less specialized health workers” (World Health Organization 2008c). All three models of care showed evidence of using task shifting and all models had non-healthcare workers conducting registration. This applied task-shifting HR strategy, by nurses or nurse assistants, shifted this task to non-healthcare workers.

The innovative underpinning of practical task-shifting from healthcare workers to non-healthcare workers was clearly identified in this study. It strongly supports one of the strategies, suggested by the WHO to solve shortages in the HIV clinic workforce, in adopting effective delivery models that will reduce the need for healthcare providers[25] (World Health Organization 2004a).

This registration activity is carried out, according to recommendations from the WHO and studies from several countries, by applying an innovative use of the task-shifting

[25] Two strategies suggested by the WHO to solve shortages in the HIV clinic workforce: increasing the numbers of these workers, and adopting effective delivery models that will reduce the need for healthcare providers.

strategy in all three hospitals (Assan et al. 2008; Callaghan et al. 2010; Morris et al. 2009; Philip et al. 2008, 2009; Shulman et al. 2009; Shumbusho et al. 2008; Van Rensburg et al. 2008; Zachariah et al. 2009).

Because the doctor shifted tasks to nurses or a designated pharmacist, nurses shifted tasks to non-healthcare workers or community healthcare workers, doctors'and nurses workloads were reduced, allowing more PLHIV to access ART services, raising service coverage while maintaining or increasing quality of care. This study found the same practices as in some other countries, such asUganda and Zambia, where ART tasks are shifted from community healthcare workers to lay workers or clinical officers (Callaghan et al. 2010; McPake and Mensah 2008; Mullan and Freywot 2007; World Health Organization 2008c). In South Africa, non-healthcare workers were not legally allowed to provide ART services themselves, but did provide practical help to healthcare workers in the delivery of those services in the three models of care explored in this study, regulations do not specify NGO volunteers working with PLHIV; but in practice, all the hospitals supported them in working as members of the ART teams (Chang et al. 2009; Chung et al. 2008; Wagner et al. 2007; Walt 1990; World Health Organization 2004a). Moreover, these non-healthcare workers helped the healthcare providers to extend their knowledge of HIV, and how to maintain good compliance to the ART service and ARV drugs, because of their personal experience of being HIV positive and receiving treatment, as well as the communication of information from their NGOs. As the review in Chapter 2 shows, the task shifting strategy reflects an increase in the accessibility of the service and competency of the heath workforce, and the efficiency of the ART service as well as an increase in the availability of the supply side. In resource-poor countries, including those in sub-Saharan Africa, non-physicians have been trained to fill various traditionally physician roles across the continent (Arem et al. 2009; Chang et al. 2008; Chang et al. 2009; World Health Organization 2004a; World Health Organization 2004b).

My findings concerning the roles and involvement of non-healthcare workers attached to NGOs accords with national data about the collaboration between NGO volunteers and healthcare providers delivering ART services in hospitals (Ministry of Public Health 2010c), and supports studies, including a report from the WHO, which recognise the contribution of non-healthcare providers to the provision of ART services in hospitals in sub-Saharan Africa, which indicates their competency in providing ART services (Arem et al. 2009; Chang et al. 2008; Chang et al. 2009; World Health Organization 2004a; World Health Organization 2004b).

I found other activities and roles of being carried out by non-healthcare providers during my study. In addition to providing registration, and basic information about HIV/AIDS, non-healthcare providers in Chonburi Regional Hospital worked in data management, supporting the screening and diagnostic activities of doctors; this activity was carried out by healthcare providers and healthcare workers in the other models of care explored in this study. This prominent involvement of non-healthcare workers in the data management of ART clinics was developed out of sheer necessity, and represented another variety of task-shifting from healthcare to non-healthcare workers. After registration came consultation with a doctor, the doctor provided symptom screening, diagnosis and treatment. It would seem that a principle of this activity would be doctor/patient contact. However, I observed that in Sanpatong District Hospital (Community-based model; Model 1) and PrachuapKhirikhan Provincial Hospital (Mixed-comprehensive model; Model 3), the tasks of diagnosis and treatment had been delegated by doctors to other professionals: nurses and designated pharmacists.PLHIV with stable treatment outcomes and follow-up without complications were treated by a nurse or pharmacist instead of a doctor. However, these patients could choose to see a doctor if they preferred. However, no data was available on how many chose to do so. Therefore the effect on the FTE of doctors cannot be estimated.

Considering the task-shifting among healthcare providers, in this community-based model, professional nurses provided services previously delivered by a doctor: screening the symptoms of PLHIV, and, if treatment outcomes were stable, without complications, prescribing ARV drugs as a one-stop service. If there were complications, patients were referred to a doctor, but because most patients followed-up without complications, doctors' workloads were considerably reduced, as presented as Table 5.14 in Chapter 5. Required FTE of nurses was 0.16, which is about half of the required FTE of all providers (0.362) to deliver ART service for one year of 1,000 PLHIV in this community-based model, whereas the FTE required of a doctor is 0.016, which is about a tenth of the FTE of nurses. This means that the nurses greatly reduced the heavy workload of doctors in providing ART services for PLHIV following up without complications. These are the majority: 90% of the total number of PLHIV following up at the hospital (274 PLHIV following up without complications from a total number of 307 PLHIV).

Several studies from other countries in sub-Saharan Africa, such as the studies in Kenya (158 Kosgei,R 2008), Malawi (McQuire et al. 2008), Nigeria (Udegboka and Moses 2009), Zambia (Torpey et al. 2008) and Rwanda (Chung et al. 2008) found positive results of the task-shifting strategy in terms of the increased efficiency of the ART programmeby reducing the workload of medical doctor and nurse to provide diagnosis and treatment of ART services. These studies found that task-shifting could solve bottleneck problems in ART services by reducing the congestion of PLHIV at clinics, and also reduce loss to follow-up. Increasing access to the ART service, which is the desired outcome of health system development, was found in studies in Botswana, Zambia (Gioris et al. 2009) and South Africa (Wood et al. 2009). Studies in South Africa also found that task-shifting improved quality of care (Kosgei et al. 2008).

Results of this study, showing that task-shifting was applied in the ART service to solve HR problems are confirmed by several other studies. Task-shifting has occurred in many countries, especially in sub-Saharan Africa, where they are confronted with a severe shortage of physician doctors and nurses (Joint Learning Initiative 2004; World Health Organization 2008c). Non-healthcare workers were trained to provide ART services instead of doctors and nurses, and to provide various other physician roles as well (McPake and Mensah 2008; Philip et al. 2009; Schneider et al. 2008; Shulman et al. 2009; Udegboka and Moses 2009; Walt 1990; World Health Organization 2004a; World Health Organization 2004b).

In Uganda and Zambia, all ART service tasks were shifted from doctors and nurses to community workers, and often further shifted from community workers to non-healthcare providers or clinical officers (Callaghan et al. 2010; McPake and Mensah 2008; Mullan and Freywot 2007; World Health Organization 2008c).

The case study of the provision of ART services in Sanpatong community presented an innovative use of task-shifting: doctors shifted tasks to nurses for PLHIV following up without complications, and also delegated ART tasks between hospitals at two levels of care. This task-shifting related to facilities from healthcare providers at the district hospital to those at sub-district hospitals, allowing ART services to be delivered in the community. Healthcare providers at the sub-district hospitals were also able to integrate ART services with home visits for other illnesses. They could build relationships with PLHIV in their sub-district area more easily than by passively waiting for PLHIV to walk into the hospital, as in the past. PLHIV were easily contacted at their homes by teams of healthcare workers and non-healthcare workers or NGO volunteers during home visits. This presents an adaptive model of care which increases the accessibility of the ART service.

The 1 year cohort study of the Lusikisiki model (Bedelu et al. 2007) found similar results to my findings of the transfer of PLHIV in the Sanpatong district. A decentralised policy was applied to ART services in the rural area of Lusikisiki in South Africa, using one hospital and 12 clinics, where they had been faced with a bottleneck when trying to scale up ART services. Decentralisation was then applied to primary health care clinics, using task-shifting (including nurse-initiated as opposed to physician-initiated treatment), and support from the community and Médecins Sans Frontières. There was a rapid scale-up of treatment, representing 95% coverage, with satisfactory outcomes.Similarly to the task-shifting of Sanpatong District Hospital, doctors at Prachaub Khirikhan Provincial Hospital shifted the tasks of screening and diagnosis to a dedicated pharmacist to follow-up PLHIV without treatment complications. This also applied HR startegy according with one of the two strategies of human resource management within ART services recommended by the WHO as a delivery model to help reduce the need for professional doctors and nurses (World Health Organization 2010d).

Prachuap Khirikhan Provincial Hospital also applied the other WHO strategy to increase the number of alternative cadres (World Health Organization 2010d), World Health

Organization 2010). They trained non-healthcare providers to provide information to PLHIV in the early morning, before they visited the dedicated pharmacist in the diagnostic room under the supervision of healthcare providers. This practice also provided a mix of different categories of healthcare providers (Dubois and Singh 2009; Dussault and Dubois 2003), thereby delivering well-rounded care within the ART service.

They also conducted other activities to solve a variety of problems: PLHIV were placed into groups according to when they started treatment,to facilitate follow-up, as described in Chapter 4; a pharmacist led the ART team instead of a doctor; nurses and non-healthcare providers assisted this pharmacist with the management and provision of demographical data concerning PLHIV, which helped to assign them to the most appropriate groups; they collaborated to establish the reasons for missed appointments, and arranged phone contact or home visits as needed. In this model of care, the doctor shifted the task of providing ART services for PLHIV following-up without complications. The designated pharmacist, who graduated with hospital pharmacy as his master degree,and had long term experience of assisting the doctor to provide ART service, as well as following up PLHIV since this hospital began to provide ART services (more than 15 years). The FTE of task shifting that the doctor allowed the designated pharmacist to provide ART for PLHIV following up without complication is 0.12, which is 40% of the total FTE of all providers (for 1,000 PLHIV) whereas the FTE of doctors is 0.024 (0.8% of total FTE of all providers); detailed findings presented in Table 5.14 in Chapter 5. This demonstrated that the task-shifting in this mixed-comprehensive model of care reduced the workload from the doctor: almost a half of the total required FTE of all providers.

The mixed-comprehensive model required the middle FTE of all providers among the three models of ART service (higher than the doctor-led model but lower than the community-based model), delivering an efficient and effective service with a zero loss to follow-up; the healthcare team having the flexibility and competence to take on different roles, as needed, in order to maintain quality of care under a variety of circumstances. They used many different strategies to adapt the ART service model, as previously explained in this chapter; in particular task-shifting, which reduced the doctors' workload with a consequent improvement in efficiency. In addition, the participation of a variety of types of non-healthcare providers in this model further increased its effectiveness when compared to that of the other two models; this important point should be considered for policy recommendation. This skill-mix characteristic was found in the other two models, but NGO volunteers did not conduct group meetings. This skill-mix strategy was another recommendation from the findings of several studies to solve the problems of workforce shortages or skill imbalances in human resource management (Buchan and Dal Poz 2002; Buchan and Calman 2005; Dubois and Singh 2009; 2012).

However, some challenges of the practice of the task-shifting were reported in some studies. For instance, in a South African study on task-shifting, tasks, including ART tasks, were shifted to professional nurses when other health professionals: doctors, pharmacists, dieticians and social workers, were absent (Van Rensburg et al 2008). This study showed the burdens of task-shifting from other professions to nurses. Comparing this to the results of my study, focusing on the community-based model, in which doctors shifted tasks to follow up PLHIV who had no complications to nurses; my study showed that the nurses and ART team were able to deliver ART service,maintaining and increasing access and quality of care, without the requirement of more nurses or supports staff.

Maintaining quality and safety of ART service were challenges when task-shifting strategy was applied. Médecins Sans Frontières' reported on the experience of scaling-up antiretroviral treatment in Malawi, South Africa. They found the challenges in, resistance of the professions and institutions, sustaining motivation and performance and preventing death of the healthcare worker from HIV/AIDS (Zachariah and et al 2009; Philips and et al 2008; Philips and et al 2009; Phillipsand Burbules 2000).

Task shifting provides more advantages than disadvantages to ART services in maintaining or increasing quality of care, proven from many studies. Similarly, the results of my study show advantages of task shifting by maintaining or increasing accessibility of ART services, as well as quality of care by the increase of CD4 levels in PLHIV after ART, and a low loss to follow up rate. It seems common in such areas that there is a natural tendency to adapt to increased workload by task-shifting. This is similar to most countries with high prevalence of HIV/AIDS and have limited number of service providers (Chung et al. 2008; Schneider et al. 2008; Stilwell et al. 2008) such as in Rwanda, Nigeria, Malawi and Kenya (Kosgei et al. 2008; McQuire et al. 2008; Torpey et al. 2008; Udegboka and Moses 2009).

B. Using skill mix

All three models of ART service applied some degree of skillmix with the participation of healthcare and non-healthcare providers. WHO suggests that if the mixed-comprehensive model has the right mix and proportions of staff, skills and experiences would provide the efficiency of the delivery service (World Health Organization 2000, 2004a; Buchan and Dal Poz 2002; Buchan and Calman 2005). However, the mixed-comprehensive model of ART services applies the mixed-skill strategy more explicitly when compared with the community-based and doctor-led models, which had some different characteristics. Similarly to the community-based model, there was a mix in staff categories, but in the mixed-comprehensive model, non-healthcare providers conducted ART activities, such as the PLHIV group meeting. This HR strategy has beenapplied to adaptive models of ART service in other countries, where nurses and community healthcare workers provide ART services together at the local level (World Health Organization 2004a; World Health Organization 2004b; Zachariah et al. 2009); South Africa (de Wet et al. 2011; Schneider et al. 2008), Haiti (Farmer et al. 2001) Lesotho (Cohen et al. 2009).

Sanpatong district adapted their model by combining skillmixwith taskshifting. Careful data-checking for clinical monitoring and drug regimens was required. This happened in sub-Saharan Africa ten years ago, because of the shortage of doctors and nurses. (Joint Learning Initiative 2004; Nathan and Edward 2011). In the doctor-led model, all PLHIV have to see a doctor to receive ART, so this model could not be applied in countries with shortages, mal-distribution or other crises in the numbers of doctors (Joint Learning Initiative 2004; Schneider et al. 2006a; Schofield 2012; Zachariah et al. 2009). As this model of care requires doctors in order to provide ART service for all cases of PLHIV, the FTE for doctors is higher than in the community-based and mixed-comprehensive models. The doctor-led model imposes a heavy workload on doctors. There is 0.15 required FTE of doctors (for 1,000 PLHIV) which is about half of the total FTE of all providers; 0.275 (50% of total FTE of all providers), whereas community-based and mixed-comprehensive models required about 10% less. However, this study revealed that in this model of care, the clinical data management ask was shifted from nurses to non-healthcare workers, who maintained data needed by doctors for diagnosis and treatment. This allowed doctors easy reference to patient data, and therefore reduced the time they spent delivering ART services. Similar systems of data management are employed in other countries which require doctors to provide ART services (Nathan and Edward 2011).

Important elements in the mixed-comprehensive model are the balancing of junior and senior staff members (Sasichey-Akkadechanunt et al. 2012), and the establishment of roles for the delivery of ART services, instead of a combination of different job titles (Buchan and Dal Poz 2002; Buchan and Calman 2005). Non-healthcare and healthcare providers work together to providedifferent aspects of care, as a multi-disciplinary teamwith the participation of NGO volunteers to conduct PLHIV group meeting; in the community-basedmodel, each ART service task is delivered by a specific provider, with the characteristic of the multidiscipline team as same as the mixed-comprehensive model. This is out of my expectation. The skill mix with the participation of non-healthcare provider was not a recommendation in the national guideline but it was an optional. In principle this practice is in line with wide global practice.

C. The participation of non-healthcare providers/ NGO volunteers as members of the ART service team

Good practice was demonstrated in several of the ART service activities in the mixed-comprehensive model of care at Prachuap Khirikhan Provincial Hospital. Non-healthcare providers helped the healthcare providers deliver group counselling, the delivery of up-to-date ART information and policy, and the monitoring and evaluation of PLHIV adherence to ARV drugs. This provided a positive opportunity for PLHIV to share information with their peers, and for them to help each other. It almost certainly released professional healthcare providers' time to allow more detailed explanations and counselling during consultations. This is not in my expectation that there would have the participation of non-healthcare provider having strong relationship with healthcare providers to provide ART service activities. However, this is similar to the findings of a study in South Africa, where lay workers provided HIV/AIDS information to PLHIV under the supervision of healthcare providers (Chang et al. 2009; Wagner et al. 2007; World Health Organization 2004a); the other two models of care did not provide group counselling.

Other studies found the participation of non-healthcare providers to be significant. A Malawian study found that lay workers who were trained as pharmacists' assistants could prescribe ARV drugs. The positive outcomes of their performance included a reduction of 25% in prescribing errors, which consequently reduced the burden on the system (Callaghan et al. 2010; Shulman et al. 2009). In principle this practice is in line with wide global practice.

D. Home-visiting: the community-based approach and its implications for human resource management

Community-based approaches areadoptedto deliver ART service in many countries, including Brazil, Argentina and Mexico (Pan American Health Organization 2003); China, Ukraine Lesotho, Mozambique and Zambia (Hanefeld and Masheke 2009); in these countries community health workers have been trained to provide ART services (Kober and Van Damme 2006; Wagner et al. 2007; World Health Organization 2004a).

This strategy allows community workers to be absorbed into the pool of human resources following WHO recommendations for HIV/AIDS prevention and care services (World Health Organization 2004a,b). Moreover, this strategy supports primary healthcare, associated with the Alma Ata primary healthcare declarationas described in the literature review in Chapter 2 (International Conference on Primary Healthcare 1978; World Health Organization 1978).

In this study, two models of ART services have used a community-based approach: the community-based model and the mixed-comprehensive model, both of which provide ART services to PLHIV in their own communities. Home visits were conducted to help contact PLHIV who were lost to follow-up or had missed appointments for some reason. They also made attempts to be seen as peers of the PLHIV in their community in order to help them have good adherence to ARV drugs. This kind of community activity in the doctor-led model at Chonburi Regional Hospital was not observed.

In Sanpatong community, healthcare providers at Sanpatong District Hospital and sub-district hospitals carried out visits to the homes of PLHIV. In the case of the sub-district hospitals, home visiting as part of ART services took place every afternoon, in collaboration with other hospital activities; included in these visits were NGO volunteer non-healthcare providers, who became peers of the PLHIV. In the community-based model of care explored by this study, professional nurses and community healthcare workers worked together at sub-district hospitals; this collaboration filled the gap of psycho-social support revealed in studies from other countries (Benjakullaya 2012; Klinbuayam 2012; Sithisak 2012; Somrin 2012).

At the Prachuap Khirikhan Provincial Hospital, healthcare providers did not provide home visits; but NGO volunteer non-healthcare providers, working as members of the ART team at the hospital, did carry out these visits, in order to follow-up PLHIV adherence to their ARV drugs, and other activities, as peers, in a similar way to the activities in the Sanpatong community. This ART service model adaption is a response to shortages and mal-distribution among the health workforce, applying a community-based approach to increase human resources.

This community-based approach suggests efficiency in the ART service. Community workers could reach the PLHIV at home, reducing the rate of loss to follow up to very low levels. This indicates the good performance of the ART team, and the competence of non-healthcare providers and community workers. They are able to deliver some ART services instead of healthcare providers, maintaining the quality of care. A South African study found that ART services originated at the community level, with local or international NGO collaboration taking a leading role in delivery (Farmer et al. 2001; Steyn et al. 2009b; Van Damme et al. 2008; Van Rensburg et al. 2008). In rural Haiti, ART services were provided by NGOs and international collaboration, through community workers who cooperated with a team of healthcare providers already providing services for Tuberculosis sufferers (Farmer et al. 2001; Koenig et al. 2004). In principle this adaptation is in line with wide global practice.

Other studies were mostly conducted in sub-Saharan Africa: in Rakai in Uganda, the community-based approach was applied in peer health promotions (Arem et al. 2009); in Cote d'Ivoire, a study found that community health workers and the NGO network helped PLHIV to access ART and ensure good adherence to ARV drugs (Attawell and Mundy 2003); in Uganda,communityhealthcare workers and professional nurses played a role in a community-based antiretroviral treatment programme in a resource-limited setting, which reported that they provided excellent AIDS care over at least a two-year period (Chang et al. 2009).

The community-based approach was applied mostly by home visiting, which benefited by increasing the accessibility of services at the local level, and improving adherence to ART. The findings from this study clearly demonstrated home visiting as the basis for an increased efficiency in ART services, proven by the decreased rate of loss to follow up.

6.1.3 Requirements, capacities and gaps in the health workforce for ART service

Many factors affect demand. Hall et al (1978), categorised these factors into eight groups; demographic, economic, social and cultural, health status, accessibility, resource availability, resource productivity and healthcare technology (Hall and Mejia 1978), whereas Hornby and et al (1980), posited eleven variables: services, available finance, health problems, population growth and change, public expectations, organizational efficiency, skill mix, individual performance, technology change, staff utilisation, and quality standards.

The literature clearly shows that ART services have had an impact on health workforces (Kober and Van Damme 2004; Kober and Van Damme 2006, 2004a). ART services were found to be labour intensive (Kober and Van Damme 2006), and many studies report a burden on health services; however, some of these studies analysed the requirements of a health workforce specifically in order to provide ART services. Most of these were based on cohort-studies, usually comprising only one observation at an ART clinic (World Health Organization 2004a). Findings from these studies presented a variety of estimations, such as the level of ART coverage and the requirements of healthcare providers, as full-time equivalents (FTE), to deliver ART services to the groups of PLHIV covered by the studies.

This study conducted an estimation based on aservice target-based approach (Dreesch et al. 2005). This study identified ART service needs, based on specific tasks and the skills required to provide them; this used ART service task analysis and the time required to provide them by healthcare providers. This data was further analysed with Markov model analysis. Meantimes were used to estimate productivity standards, to further calculate and translate the time required to provide ART services as a FTE, based on productivity. This methodological approach is unusual in its use of mixed method approach.

A. Projection of FTE required for ART services

The findings of Markov analysis showed that for all providers and all groups of PLHIV, the doctor-led model (Model 2) required the least FTE of all providers.These FTE standard units were then applied to the national database figure for the number of PLHIV being treated at the end of 2012 to estimate the requirements of the health workforce. The result indicated that the FTE of the providers required to provide ART services for one PLHIV for one year in areas with a high prevalence of HIV/AIDS, would be about 59, 45 and 45 FTE (Chapter 5: Table 5.15, p. 299), for Models 1, 2 and 3, respectively.

Doctors had the highest FTE requirement in the doctor-led model (Model 2), whereas they required seven and four times lower at about 0.000016 and 0.000024 FTE in the community-based (Model 1) and mixed-comprehensive models (Model 3), respectively.

This is because the doctor in the community-based and mixed-comprehensive models shifted their ART tasks to nurses and a designated pharmacist. Estimations of the FTE requirement of nurses and the designated pharmacists providing ART services for PLHIV following-up without complication: about 0.00016 and 0.00012 FTE for one PLHIV for one year. The FTE required for other groups of providers: pharmacists, pharmacy technicians and non-healthcare providers, was lower.

An important point regarding the FTE requirement of doctors was identified in all three models of care (Table 5.15 p. 299). The totals of 18.62, 3.89, and 2.59 FTE of doctors were estimated for providing ART services for 161,917 PLHIV for one year for the doctor-led (Model 2), mixed-comprehensive (Model 3) and community-based models (Model 1), respectively. These figures show that the doctor-led model requiredmore than six timesthe FTE of doctors as in the community-based model and nearly five times that ofthe mixed-comprehensive model. This indicates that the community-based model and mixed-comprehensive model of care can reduce the workload of the doctor. The community-based model reduces the workload of doctors the most, by shifting tasks from the doctor to the nurses whilst the mixed-comprehensive model shifted tasks from the doctor to the designated pharmacist by a further amount.

When comparing FTE figures among the three models of care it may be observed that doctors in model 1 shifted ART service tasks to nurses, reducing doctors' workload. The FTE of doctors for all PLHIV per year across the country was highest, at about 25 FTE, in the doctor-led model (Model 2), but only 4 in the mixed-comprehensive model (Model 3), and down to 3 in the community-based model (Model 1).

Similarly, in the mixed-comprehensive model (Model 3), the designated pharmacist helped the doctor to provide ART services; requiring about 19.43 FTE of pharmacists. This would appear to be significantly different.The FTE of pharmacists and non-healthcare providers was between 15 and 18 and between 7 and 13, respectively. However, findings (Figures 5.15 and 5.16) showed that the community-based model (Model 1) had the highest FTE requirement, the mixed-comprehensive model (Model 3) the lowest, and the doctor-led model (Model 2) was in the middle. In the mixed-comprehensive model (Model 3), the pharmacist prepared unit doses of ARV drugs for refilling for all groups of PLHIV on the day before the ART clinic, and the pharmacy team alone dispensed ARV drugs to PLHIV attending the ART clinic; this reduced the time required for dispensing ARV drugs. This characteristic was not in evidence in Models 1 and 2. However, the ART clinic in the community-based model (Model 1) had its own pharmacy unit separate from the main pharmacy unit, whereas in Model 2, the pharmacy unit provided drugs for other chronic and communicable diseases: hypertension, diabetes and tuberculosis; the times for dispensing all these drugs may have overlapped.

Other countries have attempted to estimate the time required to provide their ART services. Most of those studies used simple extrapolation to project and estimate the time needed, as in a Cambodian study which differed from my study appling the Markov and Monte Carlo analysis to estimate the time required to provide ART service which is the new knowledge of the area of health workforce planning. Their findings estimated that they had sufficient human resources for health to provide ART services in a doctor-led model of ART care (2-5 FTE doctors) in 2013. This agrees with the results of my study.

Hirschhorn et al estimated the number of healthcare workers required to provide ART to 1,000 patients, using 1-2 physicians, 2-7 nurses and<1 to 3 pharmacy staff (Hirschhorn et al. 2006). Another study in Malawi and Zambia estimated that they needed 85 clinical officer and doctor FTEs and 91 nurse FTEs to provide ART services to 95,674 PLHIV; these figures represented 13.9% of all clinical officers and physicians and 1.1% of all nurses.

Another study (Smith 2005) projected human resource requirements in Zambia and Mozambique would need a scaled up ART delivery model for all clinically eligible people by 2015. For this activity alone, they would require between two and four times as many doctors, respectively, as were currently available in each country for all health services. However, these figures would be far lower if they employed community health workers or other health professionals to help in providing ART services.

All the above studies were estimated by cross-sectional studies based on observations carried out over a similar period of time to that of my research; only the Cambodian study observed a more extensive one-year cohort.

To compare the findings of other studies to those of my study: my observations found that the community-based model of care (Model 1) had 7 providers; 1 doctor, 3 nurses, 2 pharmacists, 1 pharmacy technician, and one non-healthcare provider, providing ART services to about 1,000 PLHIV per year. The doctor-led model (Model 2) had 8 providers; 1 doctor, 2 pharmacists, 2 pharmacy technicians, and 3 non-healthcare providers who delivered ART services to 3,000 PLHIV in a year. The mixed-comprehensive model (Model 3) had 8 healthcare providers: 1 doctor, 1 designated pharmacist, 2 pharmacists, 2 pharmacy technicians, and 2 non-healthcare providers, who provided ART services to about 600 PLHIV in 2012.

B. Gaps between required FTE and availability of healthcare providers

The FTE requirements of all providers were estimated by each type of provider, by applying the estimated number of PLHIV, projected from the Asian epidemic model, obtaining the FTE required for the whole lives of all PLHIV. The results were in the range of 60-80 FTE required for all providers, Model 1 had the most and Models 2 and 3 the least. The availability of healthcare providers (doctor, nurse, pharmacist and pharmacy technician) was analysed to find the relationship between the FTE required to provide ART services and the availability of providers were between 0.04 and0.05 % of the total number of providers (doctors, nurses, pharmacists and pharmacy technicians) of the estimation of each model of care, to provide ART servicesfor PLHIV per year. This is low when compared to the results of studies in Malawi and Zambia, which revealed an availability of about 13.9% of all clinical officers and physicians and 1.1% of all nurses in 2007 (Muula et al. 2007). However, the FTE doctor of the doctor-led model of my study was estimated at about 0.05 to 0.09% of the proportion of the requirement and the availability from 2012 to 2025, whereas in the other two models, the proportion of the requirement and the availability was between 0.01 to 0.02%. This is lower than the doctor-led model.

The findings of my study indicate that if the Thai government provides ART services for all PLHIV at any CD4 level, the FTE requirement would increase slightly. This figure would double if almost all PLHIV were recruited into the ART service; the number of PLHIV requiring treatment would then be estimated at 570,000 PLHIV, based on the Asian Epidemic Model and the study of Van Damme et al (Thai Working Group on HIV/AIDS 2008; Van Damme et al. 2008). The FTE requirement rises slightly on an annual basis but not in excess of supply.

6.2 CONCLUSIONS

Since the Thai government implemented the universal access to ART policy in the healthcare system, as part of long term investment in strengthening the healthcare system, but without adding extra healthcare workers, there have been no studies investigate ART service delivery at any of the four levels of care of Thai healthcare system. Several studies have indicated that without strengthened healthcare systems, many developing countries are unlikely to achieve effective access to ART due to gaps in financing, and crises in human resources (Schneider and et al 2006). This study is evidence that hospitals can deliver ART services in the existing healthcare system, and maintain or increase service quality. It shows that all the ART delivery models had been adapted in a variety of ways from the practical guideline for ART service in Thailand (Bureau of AIDS, TB, and STIs 2004), by the application of different HR strategies; task-shifting, skill-mix and the participation of volunteers, community healthcare and non-healthcare workers.

To conclude, this study found that the three models of care adapted the ART services prescribed in the existing healthcare system; community-based, doctor-led, and mixed-comprehensive. They were tailored for the context in which they operated, to maintain/increase accessibility and quality of care. They adapted their organisation within the limitations of available human resource, making the best use of them in order to deliver an effective ART service. Each model had its owns specific characteristics; the community-based model, following the national policy of decentralising the healthcare system, needed a principal hospital to support facilities and closely monitor sub-district hospitals, in order to ensure good management and a strong commitment from the networks and PLHIV. The doctor-led model represented the traditional model of ART care, which relied on the leadership of doctors, and the management of patient profiles to assist doctors in the ART clinic. In the mixed-comprehensive model, multi-skills of healthcare personnel were utilised to deliver ART services, with tasks delegated from doctors to other professionals and non-professionals; NGO volunteers managed group meetings, monitored and evaluated adherence to ARV drugs, and conducted home visits.

In this study, nine main points are concluded as follow:

1. The drive to universal access in the universal coverage policy which has increased demand and suffient availability has not reduced quality of ART service as measured in this study.

2. The mixed-comprehensive and community-based approaches improve efficiency of ART service.

3. The drive of ART service towards universal access based on a combination of HR startegies appear to be successful.

4. Task-shifing is endemic to all models of care in this study and happened as an adaptive process and should be promoted.

5. Skill mix is endemic to all models of care in this study and happened as an adaptive process and should be promoted.

6. Home visiting increase efficiency and effectiveness. However, it is not as clear as other results. There is trade off between efficiency and quality of care.

7. Qualitative stage in methodology is sufficiently robust to provide input parameters for modelling propose.

8. There are enough providers to delivery ART service to 2025 in each of the adapted ART delivery approach.

9. This study provides new knowledge in the form of a tool for estimating future requirement of healthcare providers, based on Markov model and Monte Carlo analysis. This tool works.

6.3 LIMITATIONS OF THE STUDY

The study does have some limitations. Firstly, because samples were drawn only regions with a high prevalence of PLHIV, it was applied with a specific assumption in the study. However, if the study would be conducted in areas of other prevalence rate of HIV/AIDS; low to moderate prevalence, there would have to concern about different planning assumption is needed to be used.

A second limitation may be the generalisability and applicability of the study findings to other parts of the world, whose systems of health workforce management may be different to those in Thailand, which is proactive in HIV/AIDS treatment.

Thirdly, low and absent observations of healthcare providers to deliver ART service at the sub-district hospital compromise the reliability of the the sub-district hospital elements of the study, where most PLHIV received ART services during home visits from healthcare providers; limited opportunity meant that only one of these cases was observed. Similarly, low and absent observations of laboratory technicians and counsellors also compromise the reliability of these study elements, so the estimations of FTE required to provide ART services did not include these two cadres.

Fourthly, a wide range of data on HRH is not clear or easily available from the Thai HRH database and other publications, and such data as there is, is not completely reliable from the imperfect information. Therefore the study selected and applied the the data and assumptions that could find from the available publications to be used in the study which brought the results of this study with the limitation.

Fifthly, the measurement of the quality of the ART services. This study measured the outcome of ART services in this study, using the increased CD4 level of PLHIV after they received ART. For the efficiency of ART services, this study uses rate of loss to follow-up of PLHIV. The measurement of quality of care by using the increase of CD4 count, and the measurement of the efficiency of ART services by using rate of loss to followup, were identified as another limitation of this study. A variety of outcomes could be considered to determine quality of care in ART services. However, the context of limation of data collection in the limited time of the fieldwork study, allowed me to conduct this study as the data and time were available.

The other limation that could find from this study is in the analysis of the cost effectiveness of the ART delivery services. This study was not designed to explore it.

Finally, the tool developed in this study has some limitations of use from the principle of Markov analysis, base on the probability of the transitional state of the health status of PLHIV, which will depend on the probability and events that may occour for those health status. If other studies or countries would like to apply this tool, they need to carefully input the health status, or any factors that could change this status by some probability or event. Moreover, they need to carefully define suitable parameters for Markov analysis, because different contexts would provide different evidence, which would offer different parameters. Other countries can consider the case of Thailand,

and learn from it how to develop their strategic plans for HRH for ART. The global community can also use evidence from this study-research to inform countries, who could apply the outlines of the Thai health system to plan, manage or improve their own ART access policies. This will only work in the future as long as there is the same effective ARV regimen.

6.4 RECOMMENDATIONS

To make recommendations, I argued that there more needs to be understood about HR requirements and models for other parts of Thailand and other countries. The health system need to learn from the results of this study, and allow other hospitals in Thailand and internationally to apply strategies of task-shifting, skill-mix and the participation of community healthcare or non-healthcare workers, to suit their individual contexts. This should help them in reducing their own problems. They could apply task shifting to maintain/increase quality of care, while reducing the workload of some healthcare professionals, as presented in Chapter 4. The other two strategies would not reduce the workload of these professionals directly; however, other hospitals in Thailand and internationally could apply skill-mix and the participation of healthcare and non-healthcare workers in the community, to strengthen and increase different aspects of quality of care, as presented in Chapters 4 and 5. The non-healthcare workers and/or NGO volunteers, who work in the community could, under the supervision of healthcare providers, reach PLHIV and provide ART services in local communities. The evidence from this study explicitly showed benefits in reducing the workload of some healthcare professionals, as well as maintaining/ improving quality of care by reducing rate of loss to follow to zero, and increasing CD4 level, which is the target outcome of ART.

6.4.1. Specific recommendations

A. To promote and support task-shifting from doctors to other professions

From the findings of this study, all models of ART services applied task-shifting. In the community-based and mixed-comprehensive models, doctors shifted the tasks of diagnosis and treatment to nurses and designated pharmacists for PLHIV who followed up without complications. It is clear that all three models applied this task-shifting to help them maintain/increase quality and accessibility of care. Moreover, the workload of doctors was reduced dramatically (in the community-based model by about a half, and in the mixed-comprehensive model by over a half). This HR strategy needs to be promoted and supported, to be used across the country, especially for hospitals facing shortages of doctors, and hospitals which need to maintain/increase quality and accessibility of care. Other international studies also identified this benefit, as presented in the literature and discussion section in this chapter. As studies from Kenya (158 Kosgei,R 2008), Malawi (McQuire et al. 2008), Nigeria (Udegboka and Moses 2009), Zambia (Torpey et al. 2008) and Rwanda (Chung et al. 2008) have found, task shifting increased the efficiency of the ART programme,reduced the workload of doctors and nurses, and reduced rates of loss to follow-up. Moreover, studies in Botswana, Zambia (Gioris et al. 2009) and South Africa (Wood et al. 2009) found an increase in access to ART services. Studies in South Africa also found that task shifting improved quality of care (Kosgei et al. 2008). The literature clearly supports these recommendations globally.

However, there is a need to prepare ART teams before implementation. The organisation and training of nurses and other healthcare professionals to provide ART services instead of doctors is a requirement. Since they will be providing ART services for PLHIV following up without complication, doctors are required to supervise them closely when they start these tasks, in order to ensure that they will be able to provide ART services with the right skills and effective performance, to maintain/increase quality of care.

B. To promote and support the participation of non-healthcare workers in the ART team

In thecommunity-based and mixed-comprehensive models in the study, non-healthcare providers delivered benefits to the ART service, as a new type of provider in the ART team, who could reduce the workload of healthcare providers. This is important when the existing healthcare system has a limited health workforce, and the healthcare system does not provide extra numbers of health workers to deliver ART services. Non-healthcare providers could help healthcare providers to provide outreach activities in the community, as presented in this study. NGO volunteers helped healthcare providers in the community-based and mixed-comprehensive models provide registration and home visiting. Moreover, the NGO volunteers also helped the healthcare providers organise group meetings for PLHIV in the mixed-comprehensive model.

In the Thai healthcare system there are about 440 networks of NGO working towards the alleviation of HIV/AIDS across the country. The government needs to invest, strengthen and expand this network by possibly providing financial and technical support. The government also needs to work collaboratively with these networks to support them, share their knowledge and responsibilities, and listen to them, because they are the people who are close to PLHIV in the community. These NGO networkscould help healthcare providers to provide some ART services, as identified in the mixed-comprehensive model, reducing their workload; this corresponds with the recommendations of many studies which found the same benefits to health workforce management (Joint Learning Initiative 2004; Schofield 2012; Tantchou and Grue'nais 2009).

C. To plan and prepare for the continuation of the decentralisation of the ART service to the community level

Considering the need to increase accessibility and maintain/increase the quality of ART servicesfor PLHIV, the community-based model developed under the decentralised policy has encouraged easier accessto ART services in the community at sub-district hospitals, increased CD4 level, and reduced the rate of loss to follow up (zero loss rate, at sub-district hospitals), as presented in the findings from Chapter 4, and the literature'review identified the efficacy of this HR strategy internationally. A study in South Africa found that down-referring PLHIV from hospital to receive ART services at health centres, presented benefits helping them to survive, remain in receipt of services, and save travelling costs; and for healthcare providers to reduce the cost of ART services (Nathan and Edward 2011; Long and et al 2011; Fatti and et al 2010).

Another study was in Tyolo, Malawi. They identified the benefits of the decentralisation policy which delegated ART services to the primary care level, combined with task shifting that increased access to ART, with good treatment outcomes and without staff shortages (Bemelmans and et al 2010).

Policy makers should recognise the proven benefits of this model from the evidence of this study, in their efforts to scale-up ART servicesin a strong healthcare system. Policy makers should advocate that hospitals and multi-stake holders involved with the issue to consider tailoring their ART service delivery towards the trend of decentralisation with a variety of health workforce strategies, selected as appropriate, especially task-shifting, which provides a wide range of advantages as many studies have shown.

However, other countries, facing HPR challenges, which do not have a long term investment in strengthening the healthcare system, as in Thailand, should consider suiting this approach to their context. This should enable them to provide a sufficient supply of health professionals and other health providers..

D. Scale-up and widen the use of this projection tool

Other hospitals in Thailand and abroad can consider applying the use of the innovative tool from this study to estimate the HR requirement to provide ART services. The Thai government needs to consider implementing this tool to be used across the country. The findings of this study provide a tool for health workforce planning which could be used to estimate requirements, capacities and gaps, by the application of Markov analysis, so the scaling up of its use is recommended. The study shows that Markov analysis, complemented by Monte Carlo uncertainty analysis, is a tool to be used for projection for a year, or even the lifetime, of PLHIV. This tool may beuseful to health workforce planning, for estimating health workforce requirementsat the national and global level. This tool also provides advantages in the calculation of the workforce requirement of ART services and other health services for other diseases which has to take into account changes in health and treatment status, such as are presented in this study.

E. Conduct situation and gap analysis in ART services

The findings of this study come from an investigation of the three models of care of the ART service in Thailand, and describe the differences between them, and the implications of these differences for the health workforce. The simulation from the study shows staff requirements. The model used in this study is a tool for healthworkforce planning and management. However, there is a need to explore and analyse how other hospitals across the country provide ART services. Other countries can learn how this study applied the method to estimate health workforce requirements, and try to identify useful elements to apply in their own context. They could collect data using the same process as this study, or suit the method to their contexts. They could select input parameters for Markov and Monte Carlo analysis.

After situation analysis,to elicit how ART services are delivered, as well as estimating the FTE required of healthcare providers, the findings of this research would indicate the ART model that the hospitals use to deliver ART services and maintain/ increase quality to reduce the workload of the limited numbers of healthcare professionals such as the doctors, by applying HR strategies including task-shifting, skill mix and participation of community workers, to suit the existing model of ART service of hospitals across the country. The setting ofshort- and long-term priorities may be required before study and implementation.

6.4.2 Recommendations for research priorities

One of the limitations of this study was that it was deliberately conducted in areas with a high prevalence of HIV/AIDS; therefore, details of ART delivery in areas with different degrees of prevalence is unknown. The next study should investigate the ART delivery model in areas with a low and moderate prevalence. This could easily apply the same tools as this study. There would be a need to adjust the estimation tool and the data collection methods, if the sample size were changed. If more time were available for data collection, the results would more closely represent the real-life situation. For example, this study did not obtain data about the time required to provide ART services at sub-district hospitals, because the study was limited to a month for each province. This was not enough to include the three-monthly visits of PLHIV to the sub-district hospital. If at least three months or better still a whole year, were allowed for study, all relevant data: for example, for appointment frequencies, could be collected, filling the gaps and resolving some of the limitations of this research.

There is also a query whether the tool developed in this study could be applied in other settings, in countries with different ART delivery models. For instance, the categorisation of PLHIV after they receive ART services might be different to that in this study (new case, following up with complications, and following up without complications), requiring adjustment of the tool of Markov analysis, and the input parameters used to answer the research questions.

6.5 SUMMARY

The burden of HIV/AIDS has had a direct impact on the workforce of the Thai healthcare system, ever since the government committed to universal access to ART services, the change of enrolment criteria, and the implementation of decentralisation. Each of these has altered the healthcare system and started a debate about ART service delivery and its implications for the health workforce. The research questions of this study arose from queries concerning whether how the hsopiatl deliver ART services in the existing healthcare situation to maintain/increasing quality of care.

This study found that ART delivery services diverged from the national guideline. The three models of ART service were found in the exsting healthcare sysym; community-based, doctor-led and mixed-comprehensive. They have adapted their ART services to maintain quality of care and increase access by applying HR approaches such as task-shifting, and made maximum use of skill mix; also community participation, to make full use of the health workforce, and strengthen the healthcare system in local communities.

The evidence for this study can assist policy makers in considering the preparation necessary for the implementation of adaptive HR strategies, and their implications: for the community-based model, the skill mix of the participation of both healthcare and non-healthcare providers, to maintain/increase quality of care, and reduce the workload of doctors, to fill gaps in provision (doctor-led model), by tailoring the ART service to suit the context of each healthcare facility. Moreover, the new knowledge provided by, and the estimation tool developed by, this study are recommended for wider application in areas with different levels of HIV/AIDS prevalence, in Thailand and internationally.

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Annexes

Annex 1 Data record form for structured interview, open-ended interview, direct observation and data collection

Part 1 Information of selected hospital and its ART service healthcare personnel

1. Level of care (Regional / Provincial / District)

2. Number of beds beds

3. Number of healthcare providers for ART services / total healthcare providers in each cadre

Table 1 Number of healthcare providers for ART services / total healthcare providers in each cadre

Year	Doctor (ART service/total)	Nurse (ART service/total)	Pharmacist & Pharmacist assistant (ART service / total)	Counsellor (ART service / total	Lab-Technician (ART service / total)
2010					
2011					
2012					

4. Number of HIV/AIDS patients

Table 2 Number of HIV/AIDS patients

Level of CD4 count (cell/mm^3)	Number of PLHIV											
	On ART			Death			Loss to follow-up			New cases		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
<50												
51-200												
201-350												
>350												
Total												

4. Working hours of healthcare providers

Table 3 Working hours of health care providers

Time	Doctor	Nurse	Pharmacist	Counsellor	Lab-Technician
Hours per day					
Days per week					

Data record form part 2: Task allocations and roles for healthcare providers for ART services in the HIV clinic at selected hospital

Table 4 Task allocations and roles for health care providers for ART services

Categories of PLHIV	**Tasks of ART services**	**Healthcare providers**					
		Doctor	Nurse	Pharmacist	Laboratory Technician	Counsellor	Other, specify
1.Treatment initiation	1.1 Symptom screening, personal health profile and interview with PLHIV						
	1.2 The HIV/AIDS counselling before starting ART						
	2.3 Laboratory testing for clinical status						
	1.4 Treatment initiation with opportunistic prophylaxis and treatment and ART						
	1.5 Dispensing drugs						
	1.6 Counselling for drug's adherence						

	1.7 Group counselling and educating HIV/AIDS knowledge						
	1.8 Registration						
2. Follow-up without complication	2.1 Symptom screening, personal health profile and interview with PLHIV						
	2.2 Laboratory testing for clinical status				/		
	2.3 Clinical monitoring						
	2.4 Dispensing drugs						
	2.5 Counselling for drug adherence						
	2.6 Group counselling						
	2.7 Registration						
3. Follow-up with complications	3.1 Symptom screening, personal health profile and interview with PLHIV						
	3.2 Laboratory testing for clinical status						

	3.3 Clinical monitoring						
	3.4 Changing drug regimen						
	3.5 Dispensing drugs						
	3.6 Counselling for drug adherence						
	3.7 Group counselling and educating with HIV/AIDS information						
	3.8 Registration						

Annex 2 Daily data record form

Date: …/…./…. **Unit:** ………..	**Observer:** ……….. **Time record**		**Time** **(minute)**
Observation	**Start**	**Stop**	
Hospital number............ Type of PLHIV ☐ New case ☐ Follow up without Complication ☐ Follow up with complication			

Annex 3 An information sheet for healthcare providers

Queen Margaret University

EDINBURGH

เอกสารชี้แจงผู้เข้าร่วมการวิจัย

Information Sheet for healthcare providers in sampling hospitals

ข้าพเจ้าเป็นนักศึกษาระดับปริญญาเอกที่มหาวิทยาลัยควีนมาร์กาเร็ต กรุงเอดินเบอระ ประเทศสหราชอาณาจักรอังกฤษ อยู่ระหว่างทำการวิจัยเรื่อง การศึกษารูปแบบการบริการแบบใดที่เหมาะสมในการเข้าถึงบริการดูแลรักษาผู้ติดเชื้อเอชไอวีและผู้ป่วยเอดส์ด้วยยาต้านไวรัสเอชไอวีในประเทศไทย (I am a Ph.D student at Queen Margaret University investigating the universal access to Antiretroviral Therapy (ART) in Thailand, specifically, the demand for human resources for health and an alternative model of care to manage HIV/AIDS treatment)

วัตถุประสงค์ในการศึกษาเพื่อค้นหาความต้องการด้านกำลังบุคลากรด้านสาธารณสุข ในการให้บริการดูแลรักษาผู้ติดเชื้อเอชไอวีและผู้ป่วยเอดส์ในกลุ่มบุคลากรวิชาชีพ 5 ด้าน ได้แก่ แพทย์ พยาบาล เภสัชกร ผู้ให้บริการปรึกษา และเจ้าหน้าที่ทางห้องปฏิบัติการ โดยการศึกษามุ่งหมายที่จะสืบค้นและนำเสนอรูปแบบการบริการดูแลรักษาผู้ติดเชื้อเอชไอวีและผู้ป่วยโรคเอดส์ที่ประยุกต์ได้เหมาะกับบริบทของสาธารณสุขไทย ทั้งในด้านจำนวน และการกระจายที่เหมาะสมของบุคลากรสาธารณสุข (The purpose of this study is to find out the demand and capacities for human resources for health to deliver Antiretroviral Therapy services among five cadres of health care workers; physician doctor, nurse, pharmacist, counsellor and laboratory technician. The study also aims to document a new adaptive model of ART delivery in the decentralized healthcare system as well as estimate number and distribution of requirement of human resource for health by the new model of ART service)

ท่านสามารถช่วยสนับสนุนการศึกษานี้ได้โดยการลงนามในใบยินยอมเข้าร่วมโครงการ และตอบคำถามที่ข้าพเจ้าถามเพื่อเป็นข้อมูลประกอบในการศึกษาวิจัย ซึ่งข้าพเจ้าจะใช้เวลาในการซักถามท่านประมาณ 30 นาที (You can help this study by consenting to help me complete my questions following the data collecting form. I will need 30 minutes of your time)

ท่านสามารถถอนตัวจากการเข้าร่วมวิจัยได้เมื่อใดก็ตาม และข้อมูลที่ปรากฏในการวิจัยนี้จะไม่ระบุถึงชื่อท่าน หรือข้อมูลอันใดที่จะสืบค้นถึงตัวท่านได้ (You can decide to withdraw your consent at anytime. All information given during the study is confidential and no names or other information which might identify you will be used in any publication arising from the research)

หากท่านมีความประสงค์ที่จะช่วยสนับสนุนการศึกษานี้โดยรับเป็นผู้ร่วมในการวิจัย ขอได้โปรดลงนามในใบยินยอมเข้าร่วมโครงการฯ และหากท่านมีคำถามเกี่ยวกับการศึกษาวิจัยนี้ ขอได้โปรดถามข้าพเจ้าโดยไม่ต้องเกรงใจ ข้าพเจ้ายินดีที่จะตอบทุกคำถามเพื่อให้ท่านเข้าใจในการศึกษาวิจัยอย่างละเอียด นอกจากนี้ท่านยังสามารถสอบถาม อาจารย์ที่ปรึกษาประจำประเทศไทย ของงานวิจัยนี้ หรือปรึกษาที่ปรึกษากิตติมศักดิ์เพื่อไขข้อข้องใจ หรือให้ได้รับข้อมูลเพิ่มเติมจากข้อมูลรายละเอียดอาจารย์ที่ปรึกษาโดยตรง หรือที่ปรึกษกิตติมศักดิ์ (If you are willing to participate in this study, could you please complete the details in the consent form? If you have any questions about this study, please feel free to ask me to help you understand the purposes of this study. I am happy to discuss with you any concerns you may have on how this study has been conducted. You many also contact the independent advisors named overleaf for further clarification)

รายละเอียดผู้วิจัย (Contact details of the researcher)

ชื่อผู้วิจัย:	นางสาวธิดาพร จิรวัฒนะไพศาล
Name of researcher:	Thidaporn Jirawattanapisal
ที่อยู่ในไทย:	สำนักโรคเอดส์ วัณโรค และโรคติดต่อทางเพศสัมพันธ์ กรมควบคุมโรค กระทรวงสาธารณสุข นนทบุรี 11000
Address:	Ph.D Student, Institute for International Health and Development, Queen Margaret University, Edinburgh Queen Margaret University Drive Musselburgh East Lothian EH21 6UU
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รายละเอียดที่ปรึกษาโดยตรงประจำประเทศไทย

(Contact details of the independent adviser)

ชื่อที่ปรึกษา:	นายแพทย์สมศักดิ์ อรรฆศิลป์
Name of adviser:	Dr.Somsak Akksilp
	รองอธิบดีกรมควบคุมโรค
	(Deputy Director General of Department of Disease Control)
ที่อยู่:	กรมควบคุมโรค กระทรวงสาธารณสุข นนทบุรี 11000
Address:	Department of Disease Control
	Ministry of Public Health,
	Nonthaburi, Thailand, 11000
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รายละเอียดที่ปรึกษากิตติมศักดิ์

Name of adviser:	Dr.Suwit Wibulpolprasert
	Senior advisor on health system and disease control
Address:	Office of Permanent Secretariat,
	Level 5 Building 1
	Ministry of Public Health,
	Nonthaburi, Thailand, 11000
Email / Telephone:	suwit@health.moph.go.th / +6681 8236517

Name of adviser:	Dr.Viroj Tangcharoensathein
	Senior advisor on health system and health economics
Address:	International Health Policy Program
	Ministry of Public Health,
	Nonthaburi, Thailand, 11000
Email / Telephone:	Viroj@ihpp.thaigov.net / +6681 8480297

Annex 4 Consent form

Queen Margaret University

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Consent form

ใบยินยอมเข้าร่วมโครงการวิจัย

การศึกษารูปแบบการบริการแบบใดที่เหมาะสมในการเข้าถึงบริการดูแลรักษาผู้ติดเชื้อเอชไอวีและผู้ป่วยเอดส์ด้วยยาต้านไวรัสเอชไอวีในประเทศไทย

(Universal Access to Antiretroviral Therapy in Thailand: What adaptive model of care to manage human resource for health?)

ข้าพเจ้าได้อ่านและเข้าใจในเอกสารชี้แจงโครงการและใบยินยอมเข้าร่วมโครงการนี้
และได้ซักถามคำถามจนเป็นที่พอใจที่จะเข้าร่วมโครงการนี้ (I have read and understood the information sheet and this consent form. I have had an opportunity to ask questions about my participation to my satisfaction)

ข้าพเจ้าเข้าใจว่าข้าพเจ้าไม่มีส่วนได้ส่วนเสียประโยชน์ในการวิจัยนี้ (I understand that I am under no obligation to take part in this study)

ข้าพเจ้าเข้าใจว่าข้าพเจ้ามีสิทธิ์ที่จะถอดถอนตัวจากการเข้าร่วมวิจัยครั้งนี้เมื่อใดก็ตามโดยไม่ต้องชี้แจงเหตุผล (I understand that I have the right to withdraw from this study at any stage without giving any reason)

ข้าพเจ้าเข้าใจว่าข้อมูลทั้งหมดที่จะให้แก่ผู้วิจัยจะได้รับการคุ้มครองให้อยู่ในความลับไม่เปิดเผยต่อผู้อื่น (I understand that all information provided is treated as confidential and will not be released by the investigator unless required to do so by law)

ข้าพเจ้าเห็นด้วยที่จะเผยแพร่ผลงานหากไม่ปรากฏชื่อของข้าพเจ้าในผลงานนั้น (I agree that gathered for this study may be published provided my name or other information which might identify me is not used)

ข้าพเจ้า เห็นด้วยและยินดีที่จะ ร่วมการวิจัยนี้ (I agree to participate in this study)

ชื่อผู้เข้าร่วมวิจัย (Name of participant) : ______________________________

ลายเซ็น (Signature of participant): ______________________________

ลายเซ็นผู้วิจัย (Signature of researcher): ______________________________

วันที่ (Date): ______________

รายละเอียดผู้วิจัย (Contact details of the researcher)

ชื่อผู้วิจัย: นางสาวธิดาพร จิรวัฒนะไพศาล

Name of researcher: Thidaporn Jirawattanapisal

ที่อยู่ในไทย: สำนักโรคเอดส์ วัณโรค และ โรคติดต่อทางเพศสัมพันธ์ กรมควบคุมโรค
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Annex 5 Number and demographic information about participants who were observed and interviewed

No.	Selected hospital	Demographic information	Number of participants
1.	Sanpatong District Hospital	1.1 Structured interview with data record form (Annex 1) and open-ended interview to ask head of each unit to explain flow and sequence of ART service in their responsibilities Physician: head of ART clinic Nurse: head of nurse of ART clinic Pharmacist: head of pharmacy unit Laboratory technician: head of laboratory unit Counselor 1.2 Observation Physician Nurses Non-healthcare provider: volunteer 4.1 Collect data from daily data record form (Annex2) that healthcare providers recorded Pharmacists Pharmacy technicians Total	 1 1 1 1 1 1 3 1 2 1 13 people
2.	Ban Hourin Sub-district hospital	Structured interview with data record form (Annex 1) and open-ended interview to ask head of each unit to explain flow and sequence of ART service in their responsibilities Nurse: director of the hospital	 1
3.	Ban Roungngoa Sub-district hospital	Structured interview with data record form (Annex 1) and open-ended interview to ask head of each unit to explain flow and sequence of ART service in their responsibilities	

		Nurse: director of the hospital	1
4.	Ban Maekungluang Sub-district hospital	Structured interview with data record form (Annex 1) and open-ended interview to ask head of each unit to explain flow and sequence of ART service in their responsibilities Nurse: director of the hospital	 1
5.	Chonburi Regional Hospital	5.1 Structured interview with data record form (Annex 1) and open-ended interview to ask head of each unit to explain flow and sequence of ART service in their responsibilities Physician: head of ART clinic Pharmacist: head of pharmacy unit Laboratory technician: head of laboratory unit Counselor 5.2 Observation Physician Non-healthcare provider 5.3 Collect data from daily data record form (Annex2) that healthcare providers recorded Pharmacists Pharmacy technicians Total	 1 1 1 1 1 4 2 2 13 people
6.	Prachuab Khirikhan Provincial Hospital	6.1 Structured interview with data record form (Annex 1) and open-ended interview to ask head of each unit to explain flow and sequence of ART service in their responsibilities Physician: head of ART clinic Nurse: head of nurse of ART clinic Pharmacist: head of pharmacy unit Laboratory technician: head of	 1 1 1 1

		laboratory unit Counselor 6.2 Observation Physician Nurses Designated pharmacist Non-healthcare provider: volunteers 6.1Collect data from daily data record form (Annex2) that healthcare providers recorded Pharmacists Pharmacy technicians Total	 1 1 1 1 2 2 2 14 people

Annex 6 Protocol for structured interview, open-ended interview and direct observation

The structured interview, open-ended interview and direct observation were conducted inoder to collect the data at the selected hospitals. The data record form (Annex 1) was used as a tool to collect data from participants when the researcher interviewed them with this tool for a structured interview, checklist for observation and open-ended interview. Moreover, the researcher used this data record form to collect the raw data from the record of the hospitals.

1. Open-ended interview:

The researcher started to collect the data by open-ended interview:

-Please tell me to know how you and team deliver ART service since PLHIV first step at the ART clinic until the end?

-How and what do you follow up PLHIV in each visit?

The research listened and recorded the data by fillling required data in the data record form and took notes for the sequences (flow) and organization of ART service in the paper as well as the researcher backed up the interview with a digital recorder inorder to compare the data collection from handwritten, if the researcher could not catch up some data from the interviewing of participants and toincrease reliability of data that were collected. The researcher repeated what the research listened and understand to the participants.

2. Structured interview:

The next process is the interview with the data record form. The researcher started the structured interview after the participants were interviewed with open ended questions. The researcher asked the question follow the data record form (Annex 1) to collect required data by filling and checking the lists in the data record form.

3. Direct observation:

The direct observation was carried on after the open-ended and structured interview. The main activities are specified depending on three groups of patients; treatment initiation or new case, follow up without complication and follow up with complication.

The participants were observed by the researcher at ART clinic. For the pharmacy unit, the pharmacists recorded time required to dispense the drugs by using the daily record form (Annex 2).

Annex 7 Formal letter asking for permission to collect the data at hospitals

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Chonburi Hospital, Prachuab Kirikhan hospital, Sanpatong hospital, Huarin hospital, Banrongngua hospital, and Banmaekungluang hospital
Ministry of Public Health,
Thailand

IIHD
Institute for International Health & Development
Director: Dr Barbara McPake
Tel : +44 (0)131 474 0000
Fax: +44 (0)131 474 0001
Email: IIHD@qmu.ac.uk
Web: http://www.qmu.ac.uk/IIHD

19 July 2012

Dear Directors,

Re: Thidaporn Jirawattanapisal, PhD Student, Institute for International Health and Development, School of Health Sciences, Queen Margaret University, Edinburgh.

As Director of Studies for Miss Jirawattanapisal, I am writing to recommend to you the above doctoral student, who has been studying at Queen Margaret University since September 2010. She is supported in her studies by a grant from the Thai government.

Miss Jirawattanapisal has successfully passed her probationary assessment on 17 December 2011 and has drafted the first three chapters for the thesis. She has received full approval for her research from the panel of ethical committee of the university on 18 July 2012, subject to asking our permission to access your institute. The title of her work is: **Universal Access to Antiretroviral Therapy in health system strengthening in Thailand: what adaptive model of care to manage human resource for health?**

She undertake field work in Thailand for four months between August to November 2012. The six institutions where she plans to collect data are: Chonburi Hospital, Prachuab Kirikhan hospital, Sanpatong hospital, Huarin hospital, Banrongngua hospital, and Banmaekungluang hospital.

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If you require further information, I would be glad to be contacted at the email address above.

Yours sincerely,

PP Professor Barbara McPake
Director
Institute for International Health and Development

Annex 8 Ethical approval letter of Queen Margaret University ethical committee

Queen Margaret University

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Name: Thidaporn Jirawattanapisal
Status: PhD Student
Subject Area: IIHD
School: Health Sciences

Lucy Clapson
Registry Officer
Queen Margaret University
Musselburgh
East Lothian EH21 6UU

Tel: 0131 474 0000
Email: lclapson@qmu.ac.uk

18 July 2012

Dear Thidaporn

Ethical Approval – Universal access to antiretroviral therapy in Thailand: What adaptive model of care to manage human resources for health?

Thank you for submitting your revised ethical approval application for consideration by the Research Ethics Panel. The Panel has reviewed your revised documentation and Professor Nigel Gleeson, Deputy Convener of the Panel, has confirmed that he is happy to take Convener's Action to grant full ethical approval for your research.

A standard condition of this ethical approval is that you are required to notify the Panel, in advance, of any significant proposed deviation from the original protocol. Reports to the Committee are also required once the research is underway if there are any unexpected results or events that raise questions about the safety of the research. The appropriate form is available via this link: http://www.qmu.ac.uk/quality/rs/default.htm#ethics

We would like to thank you for your co-operation and wish you well with your project.

Yours sincerely

Lucy Clapson
Secretary to the Research Ethics Panel

Cc Prof Barbara McPake, Supervisor

Annex 9 Ethical approval letter of Chonburi Regional Hospital ethical committee

No. 25 /2555

Application Approval

by

The Research Committee, Chonburi Hospital

....

Project Title	:	Universal Access to Antiretroviral Therapy in Thailand: What adaptive model of care to manage human resources for health?
Main Researcher	:	Miss Thidaporn Jirawattanapisal
Organization	:	Queen Margaret University EDINBURGH

The Research Committee has approved the research proposal and permitted to conduct the study between 9 August 2012 and 31 December 2012

Date of issue : 16 August 2011

(Dr. Pongtep Chaiprasit)
Chair of the Research Committee

(Dr.Chatree Tuntiyawarong)
Director of Chonburi Hospital

Annex 10 Findings from structured interviews, open-ended interview, direct observation and data collection using data record form, at Sanpatong District Hospital

Data Record Form of Sanpatong District Hospital

Part 1 Information of Sanpatong Hospital and its ART service healthcare personnel

1. Level of care (Regional / Provincial / District)

2. Number of beds 120 beds

3. Number of healthcare providers for ART services / total healthcare providers in each cadre

Table 1 Number of healthcare providers for ART services / total healthcare providers in each cadre

Year	Doctor (ART service/total)	Nurse (ART service/total)	Pharmacist & Pharmacist assistant (ART service / total)	Counsellor (ART service / total	Lab-Technician (ART service / total)
2010	1/20	4/137	3 (2+1)/10	0	4/10
2011	1/20	4/162	3 (2+1)/10	0	4/10
2012	1/20	4/162	3 (2+1)/10	0	4/10

4. Number of HIV/AIDS patients

Table 2 Number of HIV/AIDS patients

Level of CD4 count (cell/mm^3)	Number of PLHIV											
	On ART			Death			Loss to follow-up			New cases		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
<50	5	8	23	3	10	5	0	0	0	10	11	10
51-200	81	78	70	2	7	3	2	0	0	25	11	5
201-350	211	220	209	0	8	0	1	0	0	24	19	21
>350	470	579	591	2	7	4	1	1	3	5	3	5
Total	767	885	893	7	35	12	4	1	3	64	44	41

5. Working hours of health care providers

Table 3 Working hours of health care providers

Time	Doctor	Nurse	Pharmacist	Counsellor	Lab-Technician
Hours per day	7	7	7	7	7
Days per week	5	5	5	5	5

Data record form part 2: Task allocations and roles for health care providers for ART services in the HIV clinic at Sanpatong District Hospital

Table 4 Task allocations and roles for healthcare providers for ART services

Categories of PLHIV	**Tasks of ART services**	**Health care providers**					
		Doctor	Nurse	Pharmacist	Laboratory Technician	Counsellor	Other, specify
1.Treatment initiation	1.1 Symptom screening, personal health profile and interview with PLHIV	/	/				
	1.2 The HIV/AIDS counselling before starting ART	/	/			/	
	1.3 Laboratory testing for clinical status				/		
	1.4 Treatment initiation with opportunistic prophylaxis and treatment and ART	/	/				
	1.5 Dispensing drugs			/			
	1.6 Counselling for drug's adherence	/	/	/		/	
	1.7 Group counselling and educating HIV/AIDS knowledge						

	1.8 Registration						/NGO, non-healthcare professional staff
2. Follow-up without complication	2.1 Symptom screening, personal health profile and interview with PLHIV	/	/				/
	2.2 Laboratory testing for clinical status				/		
	2.3 Clinical monitoring	/	/				
	2.4 Dispensing drugs			/			
	2.5 Counselling for drug adherence	/	/	/		/	
	2.6 Group counselling	/	/	/		/	/
	2.7 Registration						/ NGO, non-healthcare staff
3. Follow-up with complications	3.1 Symptom screening, personal health profile and interview with PLHIV	/	/	/		/	/

	3.2 Laboratory testing for clinical status				/		
	3.3 Clinical monitoring	/	/	/			
	3.4 Changing drug regimen	/		/			
	3.5 Dispensing drugs			/			
	3.6 Counselling for drug adherence	/	/	/		/	
	3.7 Group counselling and educating with HIV/AIDS information						
	3.8 Registration						/ NGO, non-healthcare staff

Annex 11 Statistical analysis of the time required to provide ART services at Sanpatong District Hospital

Annex 11A1 Normality test of registration activity of the ART services at Sanpatong District Hospital, representing the community-based model of ART services

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Register	.287	307	.000	.792	307	.000

a. Lilliefors Significance Correction

Annex 11 A2 Descriptive analysis of registration activity of the ART service at Sanpatong District Hospital, representing community-based model of ART service

N	Valid	307
	Missing	0
Mean		1.86
Std. Error of Mean		.039
Median		2.00
Mode		2
Std. Deviation		.680
Variance		.463
Range		4
Minimum		1
Maximum		5
Sum		570

Annex 11 B Diagnosisactivity

Annex 11 B1 Normality test of diagnosis activity of ART service of Sanpatong District Hospital representing of community-based model of ART service

The normality tests of either Kolmogorov-Smirnov or Shapiro-Wilk present that the time required providing screening and diagnosis service is not normal distribution because the test of normalilty of Kolmogorov-Smirnov and Shapiro-Wilk result significant different (P-Value <0.05).

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Diagnosis	.185	307	.000	.849	307	.000

a. Lilliefors Significance Correction

Annex11 B2 Descriptive analysis of diagnosis activity of ART service of Sanpatong District Hospital representing of task-delegation model of ART service

N	Valid	307
	Missing	0
Mean		4.07
Std. Error of Mean		.118
Median		4.00
Mode		3
Std. Deviation		2.073
Variance		4.296
Range		13
Minimum		1
Maximum		14
Sum		1250

Annex 11C Drug Dispensing

Annex 11 C1 Normality testof drug delivering activity of ART service of Sanpatong District Hospital representing of the community-based model of ART service

The normality tests of either Kolmogorov-Smirnov or Shapiro-Wilk present that the time required providing of drug delivering service is not normal distribution because the test of normalilty of Kolmogorov-Smirnov and Shapiro-Wilk result significant different (P-Value <0.05).

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Drug delivery	.241	307	.000	.704	307	.000

a. Lilliefors Significance Correction

Annex 11 C2 Descriptive analysis of drug delivering activity of ART service of Sanpatong District Hospital representing of community-based model of ART service

N	Valid	307
	Missing	0
Mean		2.5418
Std. Error of Mean		.13864
Median		1.6667
Mode		1.33
Std. Deviation		2.42924
Variance		5.901
Range		15.33
Minimum		.33
Maximum		15.67
Sum		780.33

Annex 11D Total time required providing three activities of ART services

Annex 11D1 Normality test of total time required providing ART service of three activities of Sanpatong District Hospital representing of community-based model of ART service

The normality tests of either Kolmogorov-Smirnov or Shapiro-Wilk present that the total time required providing of ART service is not normal distribution because the test of normalilty of Kolmogorov-Smirnov and Shapiro-Wilk result significant different (P-Value <0.05).

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Total	.131	307	.000	.901	307	.000

a. Lilliefors Significance Correction

Annex 11 D2 Descriptive analysis of total time required providing ART service of three activities of Sanpatong District Hospital representing of community-based model of ART service

N	Valid	307
	Missing	0
Mean		8.4701
Std. Error of Mean		.17590
Median		7.6667
Mode		7.00
Std. Deviation		3.08205
Variance		9.499
Range		17.00
Minimum		3.67
Maximum		20.67
Sum		2600.33

Annex 11 E Descriptive analysis presenting by three different groups of treatment status of PLHIV of ART service of Sanpatong District Hospital representing of task-delegation model of ART service

The hypothesis of the non-parametric tests for independent samples Kruskal Wallis Test is accept for no different of time required providing ART service when result of P-Value is higher than 0.05. From the test, the result of mean of time required providing ART of screening and diagnosis is lower than 0.05. Then decision is reject the null hypothesis. This means that distribution of time required providing ART service of screening and diagnosis is different is not the same across categories groups (follow up without complication, with complication and new case). The result of this distribution provides impact to the distribution of total time required providing all three services which is not the same across categories of all groups of PLHIV.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Register is the same across categories of Groups.	Independent-Samples Kruskal-Wallis Test	.877	Retain the null hypothesis.
2	The distribution of Diag is the same across categories of Groups.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
3	The distribution of Drugdelivery is the same across categories of Groups.	Independent-Samples Kruskal-Wallis Test	.954	Retain the null hypothesis.
4	The distribution of Total is the same across categories of Groups.	Independent-Samples Kruskal-Wallis Test	.002	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Descriptive analysis of **registry activity** of ART service of Sanpatong District Hospital representing of task-delegation model of ART service by groups of different states of PLHIV

	case			Statistic	Std. Error
Register	No com	Mean		1.86	.041
		95% Confidence Interval for Mean	Lower Bound	1.78	
			Upper Bound	1.94	
		5% Trimmed Mean		1.83	
		Median		2.00	
		Variance		.462	
		Std. Deviation		.680	
		Minimum		1	
		Maximum		5	
		Range		4	
		Interquartile Range		1	
		Skewness		.537	.148
		Kurtosis		.954	.295
	Com	Mean		1.82	.102
		95% Confidence Interval for Mean	Lower Bound	1.61	
			Upper Bound	2.03	
		5% Trimmed Mean		1.80	
		Median		2.00	
		Variance		.341	
		Std. Deviation		.584	
		Minimum		1	
		Maximum		3	
		Range		2	
		Interquartile Range		1	
		Skewness		.025	.409
		Kurtosis		-.089	.798
	New case	Mean		2.00	1.000
		95% Confidence Interval for Mean	Lower Bound	-2.30	
			Upper Bound	6.30	
		5% Trimmed Mean		.	
		Median		1.00	
		Variance		3.000	
		Std. Deviation		1.732	
		Minimum		1	
		Maximum		4	
		Range		3	
		Interquartile Range		.	
		Skewness		1.732	1.225
		Kurtosis		.	.

Descriptive analysis of **diagnosis activity** of ART service of Sanpatong District Hospital representing of community-based model of ART service

	case			Statistic	Std. Error
Diagnosis activity	No com	Mean		3.84	.113
		95% Confidence Interval for Mean	Lower Bound	3.62	
			Upper Bound	4.06	
		5% Trimmed Mean		3.69	
		Median		4.00	
		Variance		3.453	
		Std. Deviation		1.858	
		Minimum		1	
		Maximum		14	
		No com		13	
				2	
				1.846	.148
				6.423	.295
	Com			5.79	.490
			Lower Bound	4.79	
			Upper Bound	6.79	
				5.62	
				5.00	
				7.922	
				2.815	
				2	
				13	
		Com		11	
				4	
				1.027	.409
				.670	.798
	New case			6.00	1.000
			Lower Bound	1.70	
			Upper Bound	10.30	
				.	
				5.00	
				3.000	
				1.732	
				5	
				8	
		New case		3	
				.	
				1.732	1.225

Descriptive analysis of **drug-dispensing activity** of ART service of Sanpatong District Hospital representing of community-based model of ART service

	case			Statistic	Std. Error
Drug dispensing	No com	Mean		2.5400	.14687
		95% Confidence Interval for Mean	Lower Bound	2.2508	
			Upper Bound	2.8291	
		5% Trimmed Mean		2.2112	
		Median		1.6667	
		Variance		5.846	
		Std. Deviation		2.41786	
		Minimum		.33	
		Maximum		15.67	
		Range		15.33	
		Interquartile Range		2.00	
		Skewness		2.589	.148
		Kurtosis		8.346	.295
	Com	Mean		2.6263	.46188
		95% Confidence Interval for Mean	Lower Bound	1.6854	
			Upper Bound	3.5671	
		5% Trimmed Mean		2.2604	
		Median		1.6667	
		Variance		7.040	
		Std. Deviation		2.65330	
		Minimum		.33	
		Maximum		14.00	
		Range		13.67	
		Interquartile Range		1.50	
		Skewness		2.884	.409
		Kurtosis		10.219	.798
	New case	Mean		1.7778	.11111
		95% Confidence Interval for Mean	Lower Bound	1.2997	
			Upper Bound	2.2559	
		5% Trimmed Mean		.	
		Median		1.6667	
		Variance		.037	
		Std. Deviation		.19245	
		Minimum		1.67	
		Maximum		2.00	
		Range		.33	
		Interquartile Range		.	
		Skewness		1.732	1.225
		Kurtosis		.	.

Multiple Comparisons for the mean of screening and diagnosis among three groups of PLHIV of Sanpatong District Hospital

	(I) case	(J) case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Tamhane	No com	Com	-4.353*	.436	.000	-5.42	-3.29
		New case	-3.379*	.650	.000	-5.15	-1.60
	Com	No com	4.353*	.436	.000	3.29	5.42
		New case	.975	.779	.529	-1.01	2.96
	New case	No com	3.379*	.650	.000	1.60	5.15
		Com	-.975	.779	.529	-2.96	1.01
Dunnett T3	No com	Com	-4.353*	.436	.000	-5.42	-3.29
		New case	-3.379*	.650	.000	-5.14	-1.62
	Com	No com	4.353*	.436	.000	3.29	5.42
		New case	.975	.779	.519	-1.01	2.96
	New case	No com	3.379*	.650	.000	1.62	5.14
		Com	-.975	.779	.519	-2.96	1.01
Games-Howell	No com	Com	-4.353*	.436	.000	-5.40	-3.31
		New case	-3.379*	.650	.000	-5.09	-1.67
	Com	No com	4.353*	.436	.000	3.31	5.40
		New case	.975	.779	.435	-.96	2.91
	New case	No com	3.379*	.650	.000	1.67	5.09
		Com	-.975	.779	.435	-2.91	.96
Dunnett C	No com	Com	-4.353*	.436		-5.40	-3.31
		New case	-3.379*	.650		-5.09	-1.66
	Com	No com	4.353*	.436		3.31	5.40
		New case	.975	.779		-1.02	2.97
	New case	No com	3.379*	.650		1.66	5.09
		Com	-.975	.779		-2.97	1.02

*. The mean difference is significant at the 0.05 level.

Annex 12 Data record form of Ban Hourin Sub-District Hospital in Chiang Mai Province

Data Record Form of Ban Hourin Sub-District Hospital

Part 1 Information about Ban Hourin Sub-District Hospital and the ART service healthcare personnel

1. Level of care (Regional / Provincial / community, sub-district)
2. Number of beds 1 bed
3. Number of healthcare providers for ART services / total healthcare providers in each cadre

Table 1 Number of healthcare providers for ART services / total healthcare providers in each cadre

Year	Doctor (ART service/total)	Nurse (ART service/total)	Pharmacist (ART service/total)	Counsellor (ART service/total)	Lab-Technician (ART service/total)	Community Healthcare worker (ART service/total)
2010	0	1/1	0	0	0	2/2
2011	0	1/1	0	0	0	2/2
2012	0	1/1	0	0	0	2/2

4. Number of HIV/AIDS patients (PLHIV)

Table 2 Number of HIV/AIDS patients (PLHIV)

Level of CD4 count (cell/mm^3)	Number of PLHIV								
	On ART			Death			Loss to follow-up		
	2010	2011	2012	2010	2011	2012	2010	2011	2012
<50	0	0	0	0	0	0	0	0	0
51-100	1	0	0	0	0	0	0	0	0
101-200	3	3	2	0	0	0	0	0	0
201-350	2	2	4	0	0	0	0	0	0
>350	6	7	6	0	0	0	0	0	0
Total	12	12	12	0	0	0	0	0	0

5. Working hours of health care providers

Table 3 Working hours of health care providers

Time	Doctor	Nurse	Pharmacist	Counsellor	Lab-Technician	Community healthcare workers
Hours per day	**0**	**7**	**0**	**0**	**0**	**2**
Days per week	**0**	**5**	**0**	**0**	**0**	**2**

Annex 13 Data record form of Ban Mae-Kungluang Sub-District Hospital in Chiang Mai Province

Data Record Form of Ban Mae-Kungluang Sub-District Hospital

Part 1 Information about Ban Mae-Kungluang Sub-District Hospital and the ART service healthcare personnel

1. Level of care (Regional / Provincial / community, sub-district)
2. Number of bed 1 bed
3. Number of healthcare providers for ART services / total healthcare providers in each cadre

Table 1 Number of healthcare providers for ART services / total healthcare providers in each cadre

Year	Doctor (ART service/ total)	Nurse (ART service/total)	Pharmacist (ART service/total)	Counsellor (ART service /total)	Lab-Technician (ART service/total)	Community Healthcare worker (ART service/total)
2010	0	1/1	0	0	0	2/2
2011	0	1/1	0	0	0	2/2
2012	0	1/1	0	0	0	2/2

4. Number of HIV/AIDS patients (PLHIV)

Table 2 Number of HIV/AIDS patients (PLHIV)

Level of CD4 count (cell/mm^3)	Number of PLHIV								
	On ART			Death			Loss to follow-up		
	2010	2011	2012	2010	2011	2012	2010	2011	2012
<50	0	0	0	0	0	0	0	0	0
51-100	1	0	0	0	0	0	0	0	0
101-200	2	3	2	0	0	0	0	0	0
201-350	1	3	2	0	0	0	0	0	0
>350	6	4	6	0	0	0	0	0	0
Total	10	10	10	0	0	0	0	0	0

5. Working hours of health care providers

Table 3 Working hours of health care providers

Time	Doctor	Nurse	Pharmacist	Counsellor	Lab-Technician	Community healthcare workers
Hours per day	**0**	**7**	**0**	**0**	**0**	**2**
Days per week	**0**	**5**	**0**	**0**	**0**	**2**

Annex 14 Data record form of Ban Rongngou Sub-District Hospital in Chiang Mai Province

Data Record Form of Ban Rongngou Sub-District Hospital

Part 1 Information about Ban Rongngou Sub-District Hospital and the ART service healthcare personnel

1. Level of care (Regional / Provincial / community, sub-district)
2. Number of bed 1 bed
3. Number of healthcare providers for ART services / total healthcare providers in each cadre

Table 3 Number of healthcare providers for ART services / total healthcare providers in each cadre

Year	Doctor (ART service/total)	Nurse (ART service/ total)	Pharmacist (ART service/total)	Counsellor (ART service/ total)	Lab-Technician (ART service /total)	Community Healthcare worker (ART service/total)
2010	0	1/1	0	0	0	2/2
2011	0	1/1	0	0	0	2/2
2012	0	1/1	0	0	0	2/2

4. Number of HIV/AIDS patients (PLHIV)

Table 2 Number of HIV/AIDS patients (PLHIV)

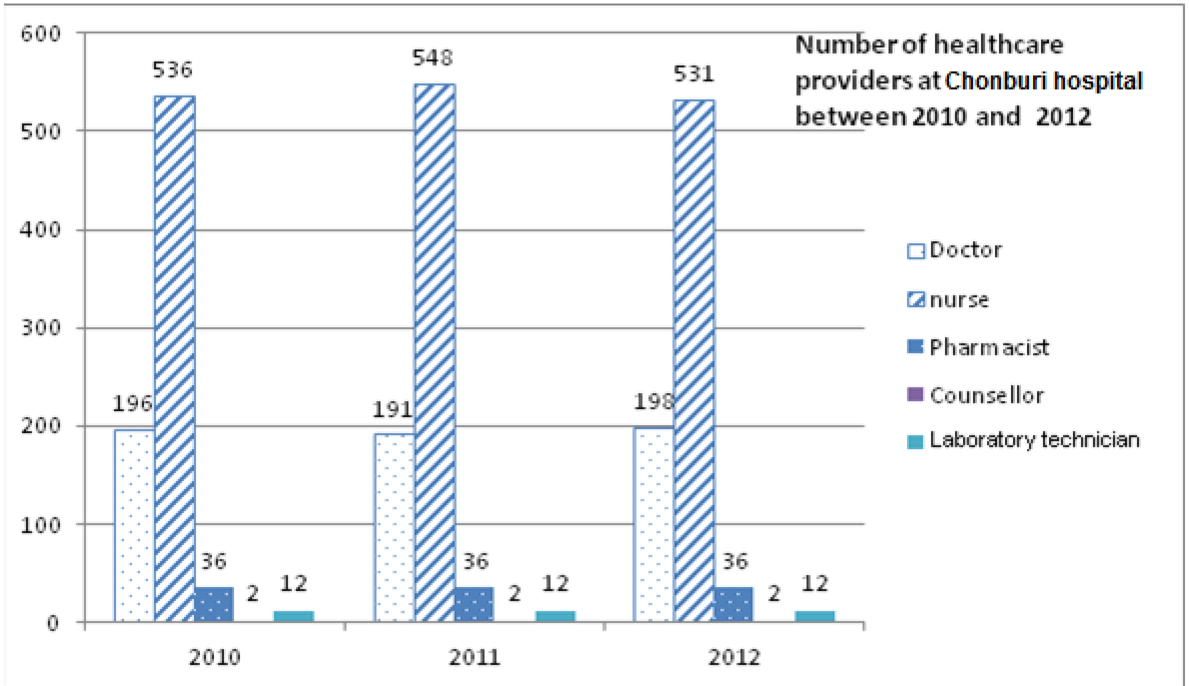
Level of CD4 count (cell/mm^3)	Number of PLHIV								
	On ART			Death			Loss to follow-up		
	2010	2011	2012	2010	2011	2012	2010	2011	2012
<50	0	0	0	0	0	0	0	0	0
51-100	1	0	0	0	0	0	0	0	0
101-200	0	1	1	0	0	0	0	0	0
201-350	2	1	1	0	0	0	0	0	0
>350	6	7	7	0	0	0	0	0	0
Total	9	9	9	0	0	0	0	0	0

5. Working hours of health care providers

Table 3 Working hours of health care providers

Time	Doctor	Nurse	Pharmacist	Counsellor	Lab-Technician	Community healthcare workers
Hours per day	**0**	**7**	**0**	**0**	**0**	**2**
Days per week	**0**	**5**	**0**	**0**	**0**	**2**

Annex 15 Numbers of healthcare providers at Chonburi Regional Hospital (2010 to 2012)



Annex 16 Findings of structureed interviews and data collection at Chonburi Regional Hospital

Data Record Form of Chonburi Regional Hospital

Part 1 Information about Chonburi Hospital and the ART service healthcare personnel

1. Level of care (Regional / Provincial / community)
2. Number of beds 825 beds
3. Number of healthcare providers for ART services / total healthcare providers in each cadre

Table 1 Number of healthcare providers for ART services / total healthcare providers in each cadre

Year	Doctor	Nurse	Pharmacist	Counsellor	Lab-Technician
2010	3/196	1/536	4/36	1/2	6/12
2011	3/191	1/548	4/36	1/2	6/12
2012	3/198	1/531	4/37	1/2	6/12

4. Number of HIV/AIDS patients

Table 2 Number of HIV/AIDS patients

Level of CD4 count (cell/mm^3)	Number of PLHIV											
	On ART			Death			Loss to follow-up			New cases		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
<100	152	145	73	14	9	16	0	0	0	N/A	N/A	N/A
101-350	877	805	771	0	0	0	0	0	0	N/A	N/A	N/A
>350	1,841	2,034	2,327	0	0	0	0	0	0	N/A	N/A	N/A
Total	2,890	2,984	3,171	14	9	16	279	96	234	N/A	N/A	N/A

5. Working hours of health care providers

Table 3 Working hours of health care providers

Time	Doctor	Nurse	Pharmacist	Counsellor	Lab-Technician
Hours per day	7	7	7	7	7
Days per week	5	5	5	5	5

Data record form part 2: Task allocations and roles of ART service health care providers in the HIV clinic at Chonburi Regional Hospital

Table 4 Task allocations and roles of ART service health care providers

Categories of PLHIV	Tasks of ART services	Health care providers					
		Doctor	Nurse	Pharmacist	Laboratory Technician	Counsellor	Other, specify
1. Initiation of treatment	1.1 Symptom screening, personal health profile and interview with PLHIV	/					/ 4 non-healthcare staffs
	1.2 The HIV/AIDS counselling before starting ART	/				/	
	1.3 Laboratory testing for clinical status				/		
	1.4 Initiation of treatment with opportunistic prophylaxis, treatment and ART	/					
	1.5 Dispensing drugs			/			
	1.6 Counselling for drug's adherence	/	/	/		/	/
	1.7 Group counselling			/			
2. Follow-up without	2.1 Symptom screening,	/		/			/ 4 non-healthcare

complication	personal health profile and interview with PLHIV						staffs
	2.2 Laboratory testing for clinical status				/		
	2.3 Clinical monitoring	/		/			
	2.4 Delivering drugs			/			/
	2.5 Counselling for drug adherence	/	/	/			/
	2.5 Group counselling			/			
3. Follow-up with complications	3.1 Symptom screening, personal health profile and interview with PLHIV	/	/	/		/	/4 non-professional healthcare staffs who are PLHIV
	3.2 Laboratory testing for clinical status				/		
	3.3 Clinical monitoring	/	/	/			
	3.4 Changing drug regimen	/		/			
	3.5 Delivering drug			/			
	3.6 Counselling for drug adherence	/	/	/			/
	3.7 Group counselling and HIV/AIDS educating			/			

Annex 17 Statistical analysis of the time required to provide ART services at Chonburi Regional Hospital, representing doctor-led model of ART service

Annex 17 A Registration

Annex 17 A1 Normality test of the registration activity of the ART service at Chonburi Regional Hospital, representing doctor-led model of ART services

The normality tests of either Kolmogorov-Smirnov or Shapiro-Wilk show that the time required to provide the **registration activity** of the ART service is not normal distribution, because both tests result in significant difference (P-Value <0.05)

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Register	.538	984	.000	.262	984	.000

a. Lilliefors Significance Correction

Annex 17 A2 Descriptive analysis of the registration activity of the ART service at Chonburi Regional Hospital, representing doctor-led model of ART service

N	Valid	984
	Missing	0
Mean		1.07
Std. Error of Mean		.008
Median		1.00
Mode		1
Std. Deviation		.255
Variance		.065
Range		2
Minimum		1
Maximum		3
Sum		1048

Annex 17 B Screening and diagnostic activity

Annex 17 B1 Normality test of the screening and diagnostic activity of the ART service at Chonburi Regional Hospital, representing a Doctor-led model of ART service

The normality tests of either Kolmogorov-Smirnov or Shapiro-Wilk show that the time required to provide the **screening and diagnosis activity** of the ART service is not normal distribution, because both tests result in significant difference (P-Value <0.05)

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Diag	.268	984	.000	.720	984	.000

a. Lilliefors Significance Correction

Annex 17 B2 Descriptive analysis of the screening and diagnostic activity of the ART service at Chonburi Regional Hospital, representing a doctor-led model of ART service

N	Valid	984
	Missing	0
Mean		2.77
Std. Error of Mean		.069
Median		2.00
Mode		2
Std. Deviation		2.175
Variance		4.731
Range		20
Minimum		1
Maximum		21
Sum		2725

Annex 17 C Drug dispensing activity

Annex 17 C1 Normality test of the drug dispensing activity of the ART service at Chonburi Regional Hospital, representing a doctor-led model of ART service
The total time required to dispense ARV drugs to all PLHIV is 10.82 $\pm$ 3.80 (Mean $\pm$ SD), delivered by 4 members of the pharmacy team, comprising 2 pharmacists and 2 pharmacist assistants.

	N	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Drug	984	2	25	10.82	.121	3.798	14.423
Valid N (listwise)	984						

I further calculated the time required per healthcare provider to deliver ARV drug dispensing services, starting with the test of normality as shown.
The normality tests of either Kolmogorov-Smirnov or Shapiro-Wilk show that the time required for the drug dispensing activity of the ART service is not normal distribution, because both tests result in significant difference (P-Value <0.05).

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Drug dispensing	.160	984	.000	.955	984	.000

a. Lilliefors Significance Correction

Annex 17 C2 Descriptive analysis of drug dispensing activity of the ART service at Chonburi Regional Hospital, representing a doctor-led model of ART service

Drug dispensing

N	Valid	984
	Missing	0
Mean		2.7040
Std. Error of Mean		.03027
Median		2.5000
Mode		2.50
Std. Deviation		.94944
Variance		.901
Range		5.75
Minimum		.50
Maximum		6.25
Sum		2660.75

Annex 17 D Thetotal time required to provide the three main activities of the ART services at Chonburi Regional Hospital, representing a Doctor-led model of ART service

Annex17 D1 Thenormality test of the total time required to provide the three main activities of the ART service at Chonburi Regional Hospital, representing a doctor-led model of ART service

The normality tests of either Kolmogorov-Smirnov or Shapiro-Wilk show that the time required to provide the total time required of the ART service is not normal distribution, because both tests result in significant difference (P-Value <0.05)

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Total	.092	984	.000	.946	984	.000

a. Lilliefors Significance Correction

Annex 17 D2 Descriptive analysis of the total time required to provide the three main activities of the ART service at Chonburi Regional Hospital, representing a doctor-led model of ART service

Total

N	Valid	984
	Missing	0
Mean		6.54
Std. Error of Mean		.082
Median		5.75
Mode		5
Std. Deviation		2.581
Variance		6.663
Range		23
Minimum		3
Maximum		26
Sum		6434

Annex 17 E Descriptive analysis presented by three different groups of treatment status of PLHIV

Non-parametric test of independent samples

The non-parametric test, with the Kruskall-Wallis test of independent samples was selected for comparing th*e mean of the time required to provide ART services to the three different groups of PLHIV.

The hypothesis of the comparison is that there is no difference among the three groups of PLHIV: following up with complications, without complications, and new cases.

The results of the test show that there is no difference in the mean of the time required to provide registration activities between different groups of PLHIV, with P-Value at 0.736, which is higher than P-Value 0.05, the value that I set for the comparison for the significant different (P-Value≤ 0.05).

Conversely, two activities: diagnosis and drug dispensing, show results from non-parametric tests indicating that there are significant differences with P-Value at 0.000, lower than 0.05. Therefore, the decision for diagnosis and drug dispensing activities is to reject the null hypothesis; this means that there is a difference in the time required for the diagnostic and drug dispensing services, significantly with P-Value at 0.05. These two activities impact on the distribution of the total time required to provide ART services, causing it to be different across categories.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Register is the same across categories of case.	Independent-Samples Kruskal-Wallis Test	.736	Retain the null hypothesis.
2	The distribution of Diag is the same across categories of case.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
3	The distribution of Drugdelivery is the same across categories of case.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
4	The distribution of Total is the same across categories of case.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Descriptive analysis of the **registration activity** of the ART service at Chonburi Regional Hospital

	case			Statistic	Std. Error
Register	No com	Mean		1.0634	.00843
		95% Confidence Interval for Mean	Lower Bound	1.0469	
			Upper Bound	1.0800	
		5% Trimmed Mean		1.0124	
		Median		1.0000	
		Variance		.064	
		Std. Deviation		.25279	
		Minimum		1.00	
		Maximum		3.00	
		Range		2.00	
		Interquartile Range		.00	
		Skewness		3.997	.082
		Kurtosis		15.912	.163
	Com	Mean		1.0845	.03324
		95% Confidence Interval for Mean	Lower Bound	1.0182	
			Upper Bound	1.1508	
		5% Trimmed Mean		1.0383	
		Median		1.0000	
		Variance		.078	
		Std. Deviation		.28013	
		Minimum		1.00	
		Maximum		2.00	
		Range		1.00	
		Interquartile Range		.00	
		Skewness		3.052	.285
		Kurtosis		7.529	.563
	New case	Mean		1.0714	.07143
		95% Confidence Interval for Mean	Lower Bound	.9171	
			Upper Bound	1.2257	
		5% Trimmed Mean		1.0238	
		Median		1.0000	
		Variance		.071	
		Std. Deviation		.26726	
		Minimum		1.00	
		Maximum		2.00	
		Range		1.00	
		Interquartile Range		.00	
		Skewness		3.742	.597
		Kurtosis		14.000	1.154

Descriptive analysis of the **diagnostic activity** of the ART service at Chonburi Regional Hospital

	case			Statistic	Std. Error
Diag	No com	Mean		2.41	.053
		95% Confidence Interval for Mean	Lower Bound	2.30	
			Upper Bound	2.51	
		5% Trimmed Mean		2.24	
		Median		2.00	
		Variance		2.524	
		Std. Deviation		1.589	
		Minimum		1	
		Maximum		16	
		Range		15	
		Interquartile Range		2	
		Skewness		2.558	.082
		Kurtosis		12.135	.163
	Com	Mean		6.76	.433
		95% Confidence Interval for Mean	Lower Bound	5.90	
			Upper Bound	7.62	
		5% Trimmed Mean		6.47	
		Median		6.00	
		Variance		13.299	
		Std. Deviation		3.647	
		Minimum		1	
		Maximum		21	
		Range		20	
		Interquartile Range		3	
		Skewness		1.522	.285
		Kurtosis		4.546	.563
	New case	Mean		5.79	.648
		95% Confidence Interval for Mean	Lower Bound	4.39	
			Upper Bound	7.19	
		5% Trimmed Mean		5.76	
		Median		6.00	
		Variance		5.874	
		Std. Deviation		2.424	
		Minimum		2	
		Maximum		10	
		Range		8	
		Interquartile Range		4	
		Skewness		-.352	.597
		Kurtosis		-.279	1.154

Descriptive analysis of the **drug dispensing activity** of the ART service at Chonburi Regional Hospital

	case			Statistic	Std. Error
Drug dispensing	No com	Mean		2.6402	.03030
		95% Confidence Interval for Mean	Lower Bound	2.5807	
			Upper Bound	2.6996	
		5% Trimmed Mean		2.6199	
		Median		2.5000	
		Variance		.825	
		Std. Deviation		.90837	
		Minimum		.50	
		Maximum		5.50	
		Range		5.00	
		Interquartile Range		1.50	
		Skewness		.154	.082
		Kurtosis		-.557	.163
	Com	Mean		3.2007	.12831
		95% Confidence Interval for Mean	Lower Bound	2.9448	
			Upper Bound	3.4566	
		5% Trimmed Mean		3.1739	
		Median		3.2500	
		Variance		1.169	
		Std. Deviation		1.08119	
		Minimum		1.00	
		Maximum		6.25	
		Range		5.25	
		Interquartile Range		1.25	
		Skewness		.357	.285
		Kurtosis		.378	.563
	New case	Mean		4.2857	.19761
		95% Confidence Interval for Mean	Lower Bound	3.8588	
			Upper Bound	4.7126	
		5% Trimmed Mean		4.2897	
		Median		4.3750	
		Variance		.547	
		Std. Deviation		.73939	
		Minimum		3.00	
		Maximum		5.50	
		Range		2.50	
		Interquartile Range		1.06	
		Skewness		-.100	.597
		Kurtosis		-.756	1.154

Descriptive analysis of the **total time of the three main activities** of the ART service of Chonburi Regional Hospital

	case			Statistic	Std. Error
Total	Com	Mean		6.11	.066
		95% Confidence Interval for Mean	Lower Bound	5.98	
			Upper Bound	6.24	
		5% Trimmed Mean		5.98	
		Median		5.75	
		Variance		3.893	
		Std. Deviation		1.973	
		Minimum		3	
		Maximum		22	
		Range		20	
		Interquartile Range		3	
		Skewness		1.708	.082
		Kurtosis		6.748	.163
	No com	Mean		11.05	.456
		95% Confidence Interval for Mean	Lower Bound	10.14	
			Upper Bound	11.96	
		5% Trimmed Mean		10.75	
		Median		10.50	
		Variance		14.772	
		Std. Deviation		3.843	
		Minimum		4	
		Maximum		26	
		Range		22	
		Interquartile Range		4	
		Skewness		1.422	.285
		Kurtosis		3.952	.563
	New case	Mean		11.14	.797
		95% Confidence Interval for Mean	Lower Bound	9.42	
			Upper Bound	12.86	
		5% Trimmed Mean		11.14	
		Median		11.50	
		Variance		8.882	
		Std. Deviation		2.980	
		Minimum		6	
		Maximum		16	
		Range		10	
		Interquartile Range		5	
		Skewness		-.341	.597
		Kurtosis		-.604	1.154

Multiple comparisons for the means of screening and diagnosis among three groups of PLHIV at Chonburi Regional Hospital

	(I) case	(J) case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Tamhane	No com	Com	-4.353*	.436	.000	-5.42	-3.29
		New case	-3.379*	.650	.000	-5.15	-1.60
	Com	No com	4.353*	.436	.000	3.29	5.42
		New case	.975	.779	.529	-1.01	2.96
	New case	No com	3.379*	.650	.000	1.60	5.15
		Com	-.975	.779	.529	-2.96	1.01
Dunnett T3	No com	Com	-4.353*	.436	.000	-5.42	-3.29
		New case	-3.379*	.650	.000	-5.14	-1.62
	Com	No com	4.353*	.436	.000	3.29	5.42
		New case	.975	.779	.519	-1.01	2.96
	New case	No com	3.379*	.650	.000	1.62	5.14
		Com	-.975	.779	.519	-2.96	1.01
Games-Howell	No com	Com	-4.353*	.436	.000	-5.40	-3.31
		New case	-3.379*	.650	.000	-5.09	-1.67
	Com	No com	4.353*	.436	.000	3.31	5.40
		New case	.975	.779	.435	-.96	2.91
	New case	No com	3.379*	.650	.000	1.67	5.09
		Com	-.975	.779	.435	-2.91	.96
Dunnett C	No com	Com	-4.353*	.436		-5.40	-3.31
		New case	-3.379*	.650		-5.09	-1.66
	Com	No com	4.353*	.436		3.31	5.40
		New case	.975	.779		-1.02	2.97
	New case	No com	3.379*	.650		1.66	5.09
		Com	-.975	.779		-2.97	1.02

*. The mean difference is significant at the 0.05 level.

Multiple comparisons for the mean of drug dispensing among three groups of PLHIV at Chonburi Regional Hospital

	(I) case	(J) case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	No com	Com	-.56055*	.13184	.000	-.8823	-.2388
		New case	-1.64556*	.19992	.000	-2.1892	-1.1019
	Com	No com	.56055*	.13184	.000	.2388	.8823
		New case	-1.08501*	.23562	.000	-1.6871	-.4829
	New case	No com	1.64556*	.19992	.000	1.1019	2.1892
		Com	1.08501*	.23562	.000	.4829	1.6871
Dunnett T3	No com	Com	-.56055*	.13184	.000	-.8820	-.2391
		New case	-1.64556*	.19992	.000	-2.1854	-1.1057
	Com	No com	.56055*	.13184	.000	.2391	.8820
		New case	-1.08501*	.23562	.000	-1.6853	-.4847
	New case	No com	1.64556*	.19992	.000	1.1057	2.1854
		Com	1.08501*	.23562	.000	.4847	1.6853
Games-Howell	No com	Com	-.56055*	.13184	.000	-.8756	-.2455
		New case	-1.64556*	.19992	.000	-2.1705	-1.1206
	Com	No com	.56055*	.13184	.000	.2455	.8756
		New case	-1.08501*	.23562	.000	-1.6713	-.4988
	New case	No com	1.64556*	.19992	.000	1.1206	2.1705
		Com	1.08501*	.23562	.000	.4988	1.6713
Dunnett C	No com	Com	-.56055*	.13184		-.8759	-.2452
		New case	-1.64556*	.19992		-2.1721	-1.1190
	Com	No com	.56055*	.13184		.2452	.8759
		New case	-1.08501*	.23562		-1.6900	-.4801
	New case	No com	1.64556*	.19992		1.1190	2.1721
		Com	1.08501*	.23562		.4801	1.6900

*. The mean difference is significant at the 0.05 level.

Multiple comparisons for the total time of the three main activities among the three groups of PLHIV at Chonburi Regional Hospital

	(I) case	(J) case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	No com	Com	-4.935*	.461	.000	-6.06	-3.81
		New case	-5.032*	.799	.000	-7.22	-2.85
	Com	No com	4.935*	.461	.000	3.81	6.06
		New case	-.097	.918	.999	-2.46	2.27
	New case	No com	5.032*	.799	.000	2.85	7.22
		Com	.097	.918	.999	-2.27	2.46
Dunnett T3	No com	Com	-4.935*	.461	.000	-6.06	-3.81
		New case	-5.032*	.799	.000	-7.20	-2.86
	Com	No com	4.935*	.461	.000	3.81	6.06
		New case	-.097	.918	.999	-2.46	2.26
	New case	No com	5.032*	.799	.000	2.86	7.20
		Com	.097	.918	.999	-2.26	2.46
Games-Howell	No com	Com	-4.935*	.461	.000	-6.04	-3.83
		New case	-5.032*	.799	.000	-7.14	-2.93
	Com	No com	4.935*	.461	.000	3.83	6.04
		New case	-.097	.918	.994	-2.40	2.21
	New case	No com	5.032*	.799	.000	2.93	7.14
		Com	.097	.918	.994	-2.21	2.40
Dunnett C	No com	Com	-4.935*	.461		-6.04	-3.83
		New case	-5.032*	.799		-7.14	-2.92
	Com	No com	4.935*	.461		3.83	6.04
		New case	-.097	.918		-2.46	2.27
	New case	No com	5.032*	.799		2.92	7.14
		Com	.097	.918		-2.27	2.46

*. The mean difference is significant at the 0.05 level.

Annex 18 The data record form of Prachuap Khirikhan Provicial Hospital

Part 1 Information of Prachuap Khirikhan Provicial Hospital and healthcare personnel for ART services

1. Level of care (Regional / Provincial / community)
2. Number of bed 300 beds
3. Number of healthcare providers for ART services / total healthcare providers in each cadre

Table 1 Number of healthcare providers for ART services / total healthcare providers in each cadre

Year	Doctor	Nurse	Pharmacist	Counsellor	Lab-Technician
2010	1/21	4/189	2/13	1/3	4/16
2011	1/23	4/191	2/14	1/3	4/16
2012	1/23	4/194	2/14	1/3	4/16

4. Number of HIV/AIDS patients

Table 2 Number of HIV/AIDS patients

Amount of CD4 count (cell/mm^3)	Number of PLHIV											
	On ART			Death			Loss to follow-up			New cases		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
<50	3	1	1	0	7	6	0	0	0	-	1	1
51-200	56	35	20	8	6	3	0	0	0	-	37	19
201-350	117	113	88	0	2	0	0	0	0	-	40	37
>350	304	311	438	0	0	0	0	0	0	-	73	77
Total	480	460	556	8	15	9	0	0	0	-	151	134

1. Working hours of health care providers

Table 3 Working hours of health care providers

Time	Doctor	Nurse	Pharmacist	Counsellor	Lab-Technician
Hours per day	7	7	7	7	7
Days per week	1	1	1	1	1

Data record form part 2: Task allocations and roles of healthcare providers for ART services in the HIV clinic at Prachuap KhirikhanProvicial Hospital

Table 4 Task allocations and roles of healthcare providers

Categories of PLHIV	**Tasks of ART services**	**Healthcare providers**					
		Doctor	Nurse	Pharmacist	Laboratory Technician	Counsellor	Other, specify
1.Treatment initiation	1.1 Screening symptom, personnel health profile and interview PLHIV	/	/	/			/ 2 Volunteer NGOs
	1.2 The HIV/AIDS counselling before starting ART	/				/	
	1.4 Laboratory testing for clinical status				/		
	1.4 Treatment initiation with opportunistic prophylaxis and ART	/		/			
	1.5 Dispensing drugs			/			
	1.6 Counselling for drug adherence	/	/	/		/	/
	1.7 Group counselling		/	/		/	/
2. Follow-up without complications	2.1 Symptom screening, personal health profile and interview with PLHIV	/	/	/			/ 2 Volunteer NGOs
	2.3 Laboratory testing for clinical status				/		
	2.3 Clinical monitoring	/	/	/			
	2.4 Dispensing drugs			/			

	2.5 Counselling for drug’s adherence	/	/	/		/	/
	2.6 Group counselling		/	/		/	/
3. Follow-up with complications	3.1 Symptom screening, personal health profile and interview with PLHIV	/	/	/			/ 2 Volunteer NGOs
	3.5 Laboratory testing for clinical status				/		
	3.6 Clinical monitoring	/	/	/			
	3.7 Changing drug regimens	/		/			
	3.5 Dispensing drugs			/			
	3.6 Counselling for drug adherence	/	/	/		/	/
	3.7 Group counselling		/	/		/	/

Annex 19 Statistical analysis of the time required to provide ART services at Prachuap Khirikhan Provincial Hospital, representing the mixed-comprehensive model of ART service

Annex 19A Registration

Annex 19A1 Normality test of registry activity of ART service of Prachuap Khirikhan Provincial Hospital representing the mixed-comprehensive model of ART service

The normality tests of either Kolmogorov-Smirnov or Shapiro-Wilk show that the time required to provide **registry service** of ART service is not normal distribution because both tests result in significant different (P-Value <0.05)

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Register	.532	235	.000	.087	235	.000

a. Lilliefors Significance Correction

Annex 18 A2 Descriptive analysis of registry activity of ART service of Prachuap Khirikhan Provincial Hospital representing of the mixed-comprehensive model of ART serv

N	Valid	232
	Missing	0
Mean		1.01
Std. Error of Mean		.007
Median		1.00
Std. Deviation		.113
Variance		.013
Range		1
Minimum		1
Maximum		2
Sum		235

Annex 19 B1 Normality test of diagnosis activity of ART service of PrachuapKhirikhan Provincial Hospital representing of the mixed-comprehensive model of ART service

The normality tests of either Kolmogorov-Smirnov or Shapiro-Wilkpresent that the time required providing **registry service** of ART service is not normal distribution because the test of normality of Kolmogorov-Smirnov and Shapiro-Wilk result significant different (P-Value <0.05)

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Diag	.212	232	.000	.774	232	.000

a. Lilliefors Significance Correction

Annex 19 B2 Descriptive analysis of the diagnostic activity of the ART service at Prachuap Khirikhan Provincial Hospital, representing the mixed-comprehensive model of ART service

Descriptive

N	Valid	232
	Missing	0
Mean		3.72
Std. Error of Mean		.194
Median		3.00
Std. Deviation		2.962
Variance		8.776
Range		17
Minimum		1
Maximum		18
Sum		862

Annex 19 C Drug dispensing

Annex 19 C1 Normality test of the diagnostic activity of the ART service at Prachuap Khirikhan Provincial Hospital, representing themixed-comprehensive model of ART service

The normality tests of either Kolmogorov-Smirnov or Shapiro-Wilk show that the time required to provide the **drug dispensing** activity of the ART service is not normal distribution, because both tests result in significant difference (P-Value <0.05)

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Drug delivery	.192	232	.000	.913	232	.000

a. Lilliefors Significance Correction

Annex 18 C2 Descriptive analysis of the drug dispensing activity of the ART service at Prachuap Khirikhan Provincial Hospital, representing the mixed-comprehensive model of ART service

N	Valid	232
	Missing	0
Mean		2.1487
Std. Error of Mean		.04832
Median		2.0000
Std. Deviation		.73596
Variance		.542
Range		3.50
Minimum		.50
Maximum		4.00
Sum		498.50

Annex 19 D Total time required to provide the three main activities of the ART services at PrachuapKhirikhan Provincial Hospital

Normality test of the total time required to provide the three main activities of the ART service at Chon Buri Regional Hospital, representing themixed-comprehensive model of ART service

Annex 19 D1 The normality tests of either Kolmogorov-Smirnov or Shapiro-Wilk show that the time required to provide the drug dispensing activity of the ART service is not normal distribution because both tests result in significant difference (P-Value <0.05)

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Total	.173	232	.000	.829	232	.000

a. Lilliefors Significance Correction

Annex 19D2 Descriptive analysis of the total time required to provide the three main activities of the ART service at Chon Buri Regional Hospital, representing the mixed-comprehensive model of ART service

N	Valid	235
	Missing	0
Mean		6.9979
Std. Error of Mean		.22133
Median		6.0000
Mode		5.50
Std. Deviation		3.39290
Variance		11.512
Range		19.00
Minimum		2.50
Maximum		21.50
Sum		1644.50

Annex 19 E Descriptive analysis of three different groups of PLHIV, categorised by treatment status, at PrachuapKhirikhan Provincial Hospital

Non-parametric test of independent samples

A non parametric test with Kruskall-Wallis test for independent samples was selected for comparing the mean of time required to provide ART services to the three different groups of PLHIV. The hypothesis of the comparison is that there is no difference among the three different groups of PLHIV.

The results of the test show that distribution of diagnosis and drug dispensing are not same across the categories of PLHIV following-up with different statuses of treatment outcome with P-Value lower than 0.05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Register is the same across categories of case.	Independent-Samples Kruskal-Wallis Test	.100	Retain the null hypothesis.
2	The distribution of Diag is the same across categories of case.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
3	The distribution of Drugdelivery is the same across categories of case.	Independent-Samples Kruskal-Wallis Test	.015	Reject the null hypothesis.
4	The distribution of Total is the same across categories of case.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Descriptive analysis of the **registration activity** of the ART service at Prachuap Khirikhan Provincial Hospital

	case			Statistic	Std. Error
Register	No com	Mean		1.01	.007
		95% Confidence Interval for Mean	Lower Bound	1.00	
			Upper Bound	1.02	
		5% Trimmed Mean		1.00	
		Median		1.00	
		Variance		.010	
		Std. Deviation		.099	
		Minimum		1	
		Maximum		2	
		Range		1	
		Interquartile Range		0	
		Skewness		10.024	.170
		Kurtosis		99.460	.339
	New case	Mean		1.08	.077
		95% Confidence Interval for Mean	Lower Bound	.91	
			Upper Bound	1.24	
		5% Trimmed Mean		1.03	
		Median		1.00	
		Variance		.077	
		Std. Deviation		.277	
		Minimum		1	
		Maximum		2	
		Range		1	
		Interquartile Range		0	
		Skewness		3.606	.616
		Kurtosis		13.000	1.191

a. Register is constant when case = 2. It has been omitted.

Descriptive analysis of the **diagnostic activity** of the ART service at Prachuap Khirikhan Provincial Hospital

	case			Statistic	Std. Error
Diag	No com	Mean		2.94	.116
		95% Confidence Interval for Mean	Lower Bound	2.71	
			Upper Bound	3.17	
		5% Trimmed Mean		2.80	
		Median		3.00	
		Variance		2.750	
		Std. Deviation		1.658	
		Minimum		1	
		Maximum		10	
		Range		9	
		Interquartile Range		2	
		Skewness		1.097	.170
		Kurtosis		1.923	.339
	Com	Mean		9.00	.963
		95% Confidence Interval for Mean	Lower Bound	6.97	
			Upper Bound	11.03	
		5% Trimmed Mean		9.06	
		Median		9.00	
		Variance		16.706	
		Std. Deviation		4.087	
		Minimum		2	
		Maximum		15	
		Range		13	
		Interquartile Range		7	
		Skewness		-.099	.536
		Kurtosis		-.712	1.038
	New case	Mean		10.15	1.176
		95% Confidence Interval for Mean	Lower Bound	7.59	
			Upper Bound	12.72	
		5% Trimmed Mean		10.00	
		Median		12.00	
		Variance		17.974	
		Std. Deviation		4.240	
		Minimum		5	
		Maximum		18	
		Range		13	
		Interquartile Range		8	
		Skewness		.083	.616
		Kurtosis		-.890	1.191

Descriptive analysis of **drug dispensing activity** of the ART service at Prachuap Khirikhan Provincial Hospital

	case			Statistic	Std. Error
Drug delivery	No com	Mean		2.1397	.05137
		95% Confidence Interval for Mean	Lower Bound	2.0384	
			Upper Bound	2.2410	
		5% Trimmed Mean		2.1057	
		Median		2.0000	
		Variance		.538	
		Std. Deviation		.73367	
		Minimum		.50	
		Maximum		4.50	
		Range		4.00	
		Interquartile Range		1.00	
		Skewness		.696	.170
		Kurtosis		.625	.339
	Com	Mean		2.7500	.24671
		95% Confidence Interval for Mean	Lower Bound	2.2295	
			Upper Bound	3.2705	
		5% Trimmed Mean		2.6944	
		Median		2.5000	
		Variance		1.096	
		Std. Deviation		1.04670	
		Minimum		1.00	
		Maximum		5.50	
		Range		4.50	
		Interquartile Range		.88	
		Skewness		1.060	.536
		Kurtosis		1.765	1.038
	New case	Mean		2.1154	.31599
		95% Confidence Interval for Mean	Lower Bound	1.4269	
			Upper Bound	2.8039	
		5% Trimmed Mean		2.0171	
		Median		2.0000	
		Variance		1.298	
		Std. Deviation		1.13933	
		Minimum		1.00	
		Maximum		5.00	
		Range		4.00	
		Interquartile Range		1.25	
		Skewness		1.463	.616
		Kurtosis		2.460	1.191

However, when I applied statistical analysis of multiple comparison with assumption of equal variance not assumed. The results of the main comparison of the drug dispensing activity show no difference of mean across the groups of PLHIV with different statuses of treatment outcome.

Multiple Comparisons for the mean of drug delivery among three groups of PLHIV of Prachuap Khirikhan Provincial Hospital

	(I) case	(J) case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	No com	Com	-.61029	.25200	.076	-1.2715	.0509
		New case	.02432	.32014	1.000	-.8555	.9042
	Com	No com	.61029	.25200	.076	-.0509	1.2715
		New case	.63462	.40090	.333	-.3922	1.6614
	New case	No com	-.02432	.32014	1.000	-.9042	.8555
		com	-.63462	.40090	.333	-1.6614	.3922
Dunnett T3	No com	Com	-.61029	.25200	.074	-1.2685	.0479
		New case	.02432	.32014	1.000	-.8487	.8974
	Com	No com	.61029	.25200	.074	-.0479	1.2685
		New case	.63462	.40090	.325	-.3890	1.6582
	New case	No com	-.02432	.32014	1.000	-.8974	.8487
		com	-.63462	.40090	.325	-1.6582	.3890
Games-Howell	No com	Com	-.61029	.25200	.064	-1.2519	.0313
		New case	.02432	.32014	.997	-.8240	.8726
	Com	No com	.61029	.25200	.064	-.0313	1.2519
		New case	.63462	.40090	.272	-.3649	1.6341
	New case	No com	-.02432	.32014	.997	-.8726	.8240
		com	-.63462	.40090	.272	-1.6341	.3649
Dunnett C	No com	Com	-.61029	.25200		-1.2546	.0340
		New case	.02432	.32014		-.8272	.8759
	Com	No com	.61029	.25200		-.0340	1.2546
		New case	.63462	.40090		-.4194	1.6886
	New case	No com	-.02432	.32014		-.8759	.8272
		com	-.63462	.40090		-1.6886	.4194

Multiple comparisons for the mean of the diagnostic activity among the three groups of PLHIV at Prachuap Khirikhan Provincial Hospital

	(I) case	(J) case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Tamhane	No com	Com	-6.064*	.970	.000	-8.62	-3.50
		New case	-7.218*	1.182	.000	-10.48	-3.95
	Com	No com	6.064*	.970	.000	3.50	8.62
		New case	-1.154	1.520	.838	-5.04	2.73
	New case	No com	7.218*	1.182	.000	3.95	10.48
		com	1.154	1.520	.838	-2.73	5.04
Dunnett T3	No com	Com	-6.064*	.970	.000	-8.61	-3.52
		New case	-7.218*	1.182	.000	-10.45	-3.98
	Com	No com	6.064*	.970	.000	3.52	8.61
		New case	-1.154	1.520	.831	-5.03	2.72
	New case	No com	7.218*	1.182	.000	3.98	10.45
		com	1.154	1.520	.831	-2.72	5.03
Games-Howell	No com	Com	-6.064*	.970	.000	-8.55	-3.58
		New case	-7.218*	1.182	.000	-10.36	-4.07
	Com	No com	6.064*	.970	.000	3.58	8.55
		New case	-1.154	1.520	.731	-4.94	2.63
	New case	No com	7.218*	1.182	.000	4.07	10.36
		com	1.154	1.520	.731	-2.63	4.94
Dunnett C	No com	Com	-6.064*	.970		-8.55	-3.58
		New case	-7.218*	1.182		-10.37	-4.07
	Com	No com	6.064*	.970		3.58	8.55
		New case	-1.154	1.520		-5.15	2.84
	New case	No com	7.218*	1.182		4.07	10.37
		com	1.154	1.520		-2.84	5.15

*. The mean difference is significant at the 0.05 level.

Multiple comparisons for the total time of the three activities among the three groups of PLHIV at PrachuapKhirikhan Provincial Hospital

	(I) case	(J) case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Tamhane	No com	Com	-6.66422*	1.10635	.000	-9.5827	-3.7457
		New case	-7.26037*	1.23312	.000	-10.6629	-3.8578
	Com	No com	6.66422*	1.10635	.000	3.7457	9.5827
		New case	-.59615	1.64496	.978	-4.7847	3.5924
	New case	No com	7.26037*	1.23312	.000	3.8578	10.6629
		com	.59615	1.64496	.978	-3.5924	4.7847
Dunnett T3	No com	Com	-6.66422*	1.10635	.000	-9.5685	-3.7599
		New case	-7.26037*	1.23312	.000	-10.6356	-3.8851
	Com	No com	6.66422*	1.10635	.000	3.7599	9.5685
		New case	-.59615	1.64496	.977	-4.7730	3.5807
	New case	No com	7.26037*	1.23312	.000	3.8851	10.6356
		com	.59615	1.64496	.977	-3.5807	4.7730
Games-Howell	No com	Com	-6.66422*	1.10635	.000	-9.4942	-3.8343
		New case	-7.26037*	1.23312	.000	-10.5390	-3.9817
	Com	No com	6.66422*	1.10635	.000	3.8343	9.4942
		New case	-.59615	1.64496	.930	-4.6764	3.4841
	No com	Com	7.26037*	1.23312	.000	3.9817	10.5390
		New case	.59615	1.64496	.930	-3.4841	4.6764
Dunnett C	No com	Com	-6.66422*	1.10635		-9.4988	-3.8296
		New case	-7.26037*	1.23312		-10.5454	-3.9754
	No com	Com	6.66422*	1.10635		3.8296	9.4988
		New case	-.59615	1.64496		-4.9096	3.7173
	No com	Com	7.26037*	1.23312		3.9754	10.5454
		New case	.59615	1.64496		-3.7173	4.9096

*. The mean difference is significant at the 0.05 level.

Annex 20 Non-parametric independent tests for independent samples of three different models of care

The non-parametric test with Kruskall-Wallis test for independent sample was selected for comparing the mean of time required to provide ART services in the three different models of care. The hypothesis of the comparison is that there is no difference among the three different groups of PLHIV. Then reject null hypothesis at (P-Value $\leq$0.05). The results of the test show that there are differences in the means of the time required to provide ART services among the three models of care, for each activity, and for the total times of the ART service (P-Value $\leq$0.05)

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Register is the same across categories of Hospitals.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
2	The distribution of Diagnosis is the same across categories of Hospitals.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
3	The distribution of Drugdelivery is the same across categories of Hospitals.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
4	The distribution of Total is the same across categories of Hospitals.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Multiple Comparisons of mean of time required providing ART services of three different models of care

Dependent Variable		(I) Hospitals	(J) Hospitals	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Register	Tamhane	No com	Com	.79164*	.03968	.000	.6964	.8869
			New case	.84391*	.03952	.000	.7491	.9388
		Com	No com	-.79164*	.03968	.000	-.8869	-.6964
			New case	.05227*	.01095	.000	.0261	.0785
		New case	No com	-.84391*	.03952	.000	-.9388	-.7491
			com	-.05227*	.01095	.000	-.0785	-.0261
	Dunnett T3	No com	Com	.79164*	.03968	.000	.6964	.8868
			New case	.84391*	.03952	.000	.7491	.9388
		Com	No com	-.79164*	.03968	.000	-.8868	-.6964
			New case	.05227*	.01095	.000	.0261	.0785
		New case	No com	-.84391*	.03952	.000	-.9388	-.7491
			com	-.05227*	.01095	.000	-.0785	-.0261
	Games-Howell	No com	Com	.79164*	.03968	.000	.6982	.8850
			New case	.84391*	.03952	.000	.7509	.9370
		Com	No com	-.79164*	.03968	.000	-.8850	-.6982
			New case	.05227*	.01095	.000	.0266	.0780
		New case	No com	-.84391*	.03952	.000	-.9370	-.7509
			com	-.05227*	.01095	.000	-.0780	-.0266
	Dunnett C	No com	Com	.79164*	.03968		.6982	.8851
			New case	.84391*	.03952		.7508	.9370
		Com	No com	-.79164*	.03968		-.8851	-.6982
			New case	.05227*	.01095		.0265	.0780
		New case	No com	-.84391*	.03952		-.9370	-.7508
			com	-.05227*	.01095		-.0780	-.0265

Dependent Variable		(I) Hospitals	(J) Hospitals	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Diagnosis	Tamhane	No com	Com	1.30235*	.13711	.000	.9739	1.6308
			New case	.27166	.23322	.569	-.2876	.8309
		Com	No com	-1.30235*	.13711	.000	-1.6308	-.9739
			New case	-1.03069*	.21262	.000	-1.5413	-.5201
		New case	No com	-.27166	.23322	.569	-.8309	.2876
			com	1.03069*	.21262	.000	.5201	1.5413
	Dunnett T3	No com	Com	1.30235*	.13711	.000	.9740	1.6307
			New case	.27166	.23322	.569	-.2875	.8309
		Com	No com	-1.30235*	.13711	.000	-1.6307	-.9740
			New case	-1.03069*	.21262	.000	-1.5412	-.5202
		New case	No com	-.27166	.23322	.569	-.8309	.2875
			com	1.03069*	.21262	.000	.5202	1.5412
	Games-Howell	No com	Com	1.30235*	.13711	.000	.9801	1.6246
			New case	.27166	.23322	.475	-.2770	.8204
		Com	No com	-1.30235*	.13711	.000	-1.6246	-.9801
			New case	-1.03069*	.21262	.000	-1.5316	-.5298
		New case	No com	-.27166	.23322	.475	-.8204	.2770
			com	1.03069*	.21262	.000	.5298	1.5316
	Dunnett C	No com	Com	1.30235*	.13711		.9797	1.6250
			New case	.27166	.23322		-.2782	.8216
		Com	No com	-1.30235*	.13711		-1.6250	-.9797
			New case	-1.03069*	.21262		-1.5319	-.5294
		New case	No com	-.27166	.23322		-.8216	.2782
			com	1.03069*	.21262		.5294	1.5319

Dependent Variable		(I) Hospitals	(J) Hospitals	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Drugdelivery	Tamhane	No com	Com	-.16221	.14191	.585	-.5028	.1783
			New case	.67372*	.16467	.000	.2792	1.0682
		Com	No com	.16221	.14191	.585	-.1783	.5028
			New case	.83593*	.09386	.000	.6105	1.0613
		New case	No com	-.67372*	.16467	.000	-1.0682	-.2792
			com	-.83593*	.09386	.000	-1.0613	-.6105
	Dunnett T3	No com	Com	-.16221	.14191	.584	-.5027	.1783
			New case	.67372*	.16467	.000	.2793	1.0682
		Com	No com	.16221	.14191	.584	-.1783	.5027
			New case	.83593*	.09386	.000	.6106	1.0613
		New case	No com	-.67372*	.16467	.000	-1.0682	-.2793
			com	-.83593*	.09386	.000	-1.0613	-.6106
	Games-Howell	No com	Com	-.16221	.14191	.488	-.4963	.1719
			New case	.67372*	.16467	.000	.2866	1.0608
		Com	No com	.16221	.14191	.488	-.1719	.4963
			New case	.83593*	.09386	.000	.6148	1.0570
		New case	No com	-.67372*	.16467	.000	-1.0608	-.2866
			com	-.83593*	.09386	.000	-1.0570	-.6148
	Dunnett C	No com	Com	-.16221	.14191		-.4964	.1720
			New case	.67372*	.16467		.2857	1.0617
		Com	No com	.16221	.14191		-.1720	.4964
			New case	.83593*	.09386		.6147	1.0572
		New case	No com	-.67372*	.16467		-1.0617	-.2857
			com	-.83593*	.09386		-1.0572	-.6147

Dependent Variable		(I) Hospitals	(J) Hospitals	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Total time required	Tamhane	No com	Com	-1.76589*	.22031	.000	-2.2932	-1.2385
			New case	1.47227*	.28271	.000	.7948	2.1497
		Com	No com	1.76589*	.22031	.000	1.2385	2.2932
			New case	3.23815*	.25804	.000	2.6196	3.8567
		New case	No com	-1.47227*	.28271	.000	-2.1497	-.7948
			com	-3.23815*	.25804	.000	-3.8567	-2.6196
	Dunnett T3	No com	Com	-1.76589*	.22031	.000	-2.2932	-1.2386
			New case	1.47227*	.28271	.000	.7949	2.1496
		Com	No com	1.76589*	.22031	.000	1.2386	2.2932
			New case	3.23815*	.25804	.000	2.6196	3.8567
		New case	No com	-1.47227*	.28271	.000	-2.1496	-.7949
			com	-3.23815*	.25804	.000	-3.8567	-2.6196
	Games-Howell	No com	Com	-1.76589*	.22031	.000	-2.2834	-1.2484
			New case	1.47227*	.28271	.000	.8076	2.1369
		Com	No com	1.76589*	.22031	.000	1.2484	2.2834
			New case	3.23815*	.25804	.000	2.6312	3.8451
		New case	No com	-1.47227*	.28271	.000	-2.1369	-.8076
			com	-3.23815*	.25804	.000	-3.8451	-2.6312
	Dunnett C	No com	Com	-1.76589*	.22031		-2.2841	-1.2476
			New case	1.47227*	.28271		.8058	2.1387
		Com	No com	1.76589*	.22031		1.2476	2.2841
			New case	3.23815*	.25804		2.6303	3.8460
		New case	No com	-1.47227*	.28271		-2.1387	-.8058
			com	-3.23815*	.25804		-3.8460	-2.6303

*. The mean difference is significant at the 0.05 level.